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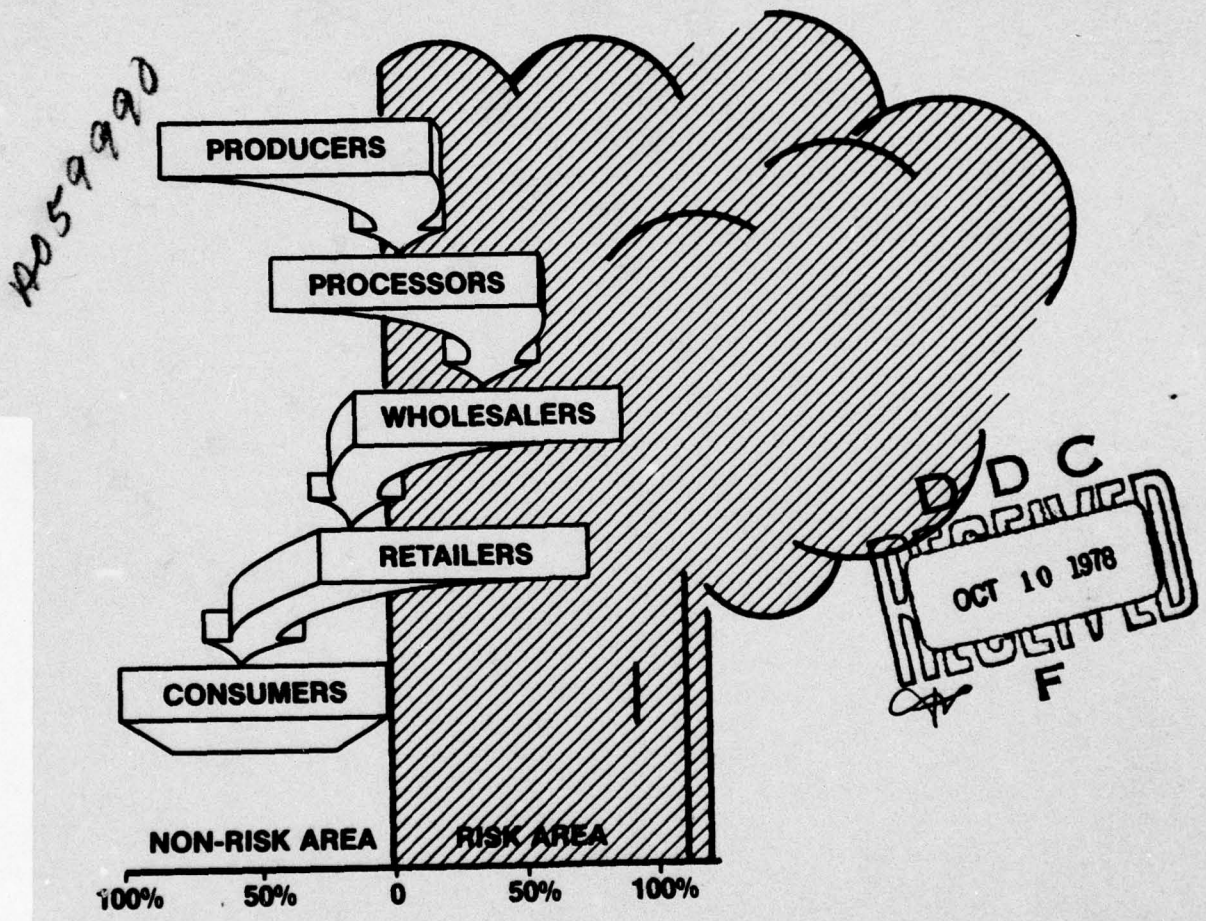
FINAL REPORT

Effects of Attack on Food Distribution to the Relocated Population

VOLUME I: ANALYSIS AND CASE STUDY



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This study extends previous research into food distribution under crisis relocation conditions by (1) investigating the effects of a nuclear attack on the reconfigured food distribution system and the relocated population, (2) identifying and evaluating alternative means of providing food to the relocated population following such an attack, and (3) reviewing existing crisis

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relocation guidance in the light of the probable postattack consequences.

Under a crisis relocation strategy, the percentage of population surviving a nuclear attack is likely to exceed both the percentage of surviving agricultural resources and the surviving food processing and distribution capability. A case study of Colorado Springs, Colorado indicates that two of the most serious food distribution problems following an attack are likely to be (1) transportation system strain resulting from geographic supply/demand imbalances; and (2) local distribution breakdowns resulting from damage to vulnerable wholesale warehouses. Each of these problems will be exacerbated by a strategy of crisis relocation.

In the long run, both the national food distribution system and its local Colorado extension appear to be sufficiently flexible to adapt to a wide range of postattack conditions. However, neither the national nor the local system as currently constituted can be altered as quickly as immediate postattack conditions might warrant. Critical shortages of most commodities can be anticipated immediately following an attack, with shortages of meat and dairy products being particularly severe.

On the basis of the case study, prototype crisis relocation plans for the State of Colorado, the Colorado Springs area, and a representative reception area (Fremont County, Colorado) have been revised and updated to reflect postattack concerns. Guidelines for state and local relocation planners in other areas have been similarly updated.

PREFACE

This report was prepared as part of a series of concurrent studies undertaken by the Defense Civil Preparedness Agency to investigate the potential planning and implementation problems associated with a crisis relocation strategy designed to transfer populations from high-risk areas during periods of severe international crisis. The report was prepared under Contract DCPA01-76-C-0312, and addresses the problems incurred in distributing food to survivors of an attack preceded by a crisis relocation. The research described in the report was accomplished over a one-year period in the Los Altos, California offices of SYSTAN, Inc. under the direction of Dr. John W. Billheimer, with assistance from Mr. Arthur Simpson. Mr. Simpson was responsible for tracing the flow of individual commodities from producer to consumer, and assessing nuclear attack damage at national and local levels. Ms. Gail Fondahl helped to assemble and interpret data on food distribution and developed simplified procedures for computing transportation stress, while Ms. Carole Parker organized and edited the final report.

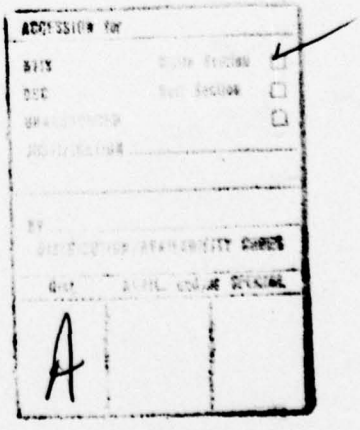
In serving as technical monitor on the project, Mr. George Van den Berghe of DCPA provided technical guidance throughout the investigation, and helped to establish convenient avenues of liaison with concurrent crisis relocation studies. At the national level, Mr. Steve Birmingham and Mr. Hanford Edsall of DCPA also supplied useful guidance, while Mr. Frank Mollner of DCPA Region VI provided valuable background information on the Colorado Springs Study Area.

This report has been prepared in three volumes:

Volume I: Analysis and Case Study

Volume II: Revised Planning Guidelines

Volume III: Prototype Plans (limited distribution)



SUMMARY

INTRODUCTION

Past research into food distribution under emergency conditions has traced the existing food supply network, investigated postattack food availability and accessibility under a strategy of in-place protection, suggested promising means of reconfiguring the existing distribution network to meet the needs of populations evacuated from central cities under a crisis relocation strategy, and developed and documented guidelines for food distribution under crisis relocation conditions. The current study extends the previous research by (1) investigating the effects of a nuclear attack on the reconfigured food distribution system and the relocated population, (2) identifying and evaluating alternative means of providing food to the relocated population following such an attack, and (3) reviewing existing crisis relocation guidance in the light of the probable postattack consequences.

APPROACH

To assess the impacts of nuclear attack on a reconfigured distribution network under a crisis relocation strategy, the current investigation has developed a quantitative picture of food distribution networks serving a sample study area: Colorado Springs, Colorado. Supplies in the food distribution network have been traced from producer to consumer, and the location and size of inventories in each stage of the distribution network have been plotted on a commodity-by-commodity basis for the eight food groups of meat, milk, eggs, cereals and cereal products, fruits and vegetables, food fats and oils, potatoes, and sugar. To provide a basis for assessing the probable postattack adequacy of the reconfigured food distribution system in the sample city, a hypothetical nuclear attack was postulated, and each element of the distribution system from producer to consumer underwent a damage assessment analysis. The results of this damage assessment were applied to the preattack commodity-flow model to predict the probable postattack flow of the selected food groups to host-area survivors. The surviving distribution system was examined for bottlenecks that might be caused by losses in production capability, labor productivity, supply availability, warehousing space, and transportation accessibility. The postattack inventories derived in this manner were compared with the U.S. Department of Agriculture's National Emergency Food Consumption standards to determine the degree to which supplies of the selected commodities could be expected to meet the requirements of survivors. Alternative postattack

distribution strategies capable of meeting these requirements were postulated and evaluated, and promising strategies were examined for components which could be incorporated into the preattack guidance for the relocation effort.

RESULTS OF DAMAGE ASSESSMENT

General Nationwide Picture

In previous postattack studies based on assumptions of in-place protection in available shelters, the aggregate survival of the nation's agricultural resources exceeded population survival. Under a crisis relocation strategy, however, the percentage of population surviving a nuclear attack is likely to exceed both the percentage of surviving agricultural resources and the surviving food processing capability. Nationwide estimates indicate that 90 percent of the U.S. population could be expected to survive a nuclear attack following a successfully executed crisis relocation strategy. By way of contrast, the most optimistic current estimate for the survival of the nation's agricultural crops sets an 82 percent survival rate, while the survival of livestock and poultry ranges from 54 to 63 percent of the current supply. Only 45 percent of the nation's current food processing capability is expected to survive an attack of the magnitude considered in this research. Exhibit 1 summarizes the projected attack damage for eight primary commodity groups and identifies cases in which shortages can be anticipated in the short and long term following an attack. In the short term, nationwide shortages of most commodities can be anticipated immediately following an attack, with shortages of meat and dairy products being particularly severe.

Two of the most serious food distribution problems likely to emerge following an attack will be:

1. Strain on the transportation network resulting from geographic supply/demand imbalances; and

2. Local distribution breakdowns resulting from damage to vulnerable wholesale warehouses.

Each of these problems will be exacerbated by a strategy of crisis relocation. The survival of additional people in areas removed from traditional distribution centers can be expected to intensify the stress imposed on the damaged transportation system by the geographic separation between remaining food stocks and the surviving population. Furthermore, the guidelines for food distribution under crisis relocation conditions rely heavily on the continued operation of the most vulnerable element of the local distribution system, the risk-area wholesale warehouse. The loss of these warehouses in an attack will remove both important food inventories and a crucial staging element in the distribution system.

EXHIBIT S.1

RELATIVE NATIONWIDE VULNERABILITY OF CRITICAL FOOD COMMODITIES

Commodity	Projected Attack Damage			Likely Postattack Availability and Accessibility	
	Production Capability	Processing Capability	Stockpiles	Short-Term	Long-Term
Meat	Moderate	Moderate-Heavy	No Significant Stockpiles	Severe Shortage	Shortage
Milk	Moderate	Moderate-Heavy	No Significant Stockpiles	Severe Shortage	Shortage
Eggs	Moderate	Moderate	No Significant Stockpiles	Shortage	Slight Shortage
Cereals	Light*	Moderate-Heavy	Light-Moderate	Severe shortages of processed stocks; ample supplies of raw grain, which will require transportation.	Sufficient Stock
Fruits and Vegetables	Light-Moderate	Light-Moderate	No Significant Stockpiles	Slight Shortages	Sufficient Stock
Food Fats and Oils	Light	Moderate-Heavy	Moderate	Slight Shortages	Sufficient Stock
Potatoes	Light*	Light-Moderate	Light	Slight Shortages	Sufficient Stock
Sugar	Light*	Moderate-Heavy	Moderate	Slight Shortages	Sufficient Stock

*Damage is light if attack occurs any time other than the early growth and reproductive stages following planting. If an attack occurs when the crop is in this vulnerable stage (around early June), damage will be moderate to heavy. Heaviest damage to soybeans will be in August.

LEGEND

Damage	Percent Surviving	Damage	Percent Surviving
Light	80-100%	Moderate-Heavy	40-50%
Light-Moderate	70-50%	Heavy	0-40%
Moderate	50-70%		

(Percentage figures are for D+30)

Colorado Springs Findings

Under a crisis relocation strategy, approximately 98 percent of the Colorado Springs risk and host area population is expected to survive the postulated attack. At some time during the first month following an attack, these survivors can expect to experience severe shortages of every commodity except potatoes and raw grain. Although supplies of refined sugar are likely to drop, requirements for sugar will drop even further, so that critical shortages of this commodity are not anticipated. The survival of Colorado's crop and livestock resources approximate nationwide survival rates. However, the Colorado food processing industry is heavily concentrated in Denver and suffers far heavier damage than is experienced nationwide. The survival rate for all Colorado food processors except sugar refiners and fruit and vegetable canners averaged 15 percent of preattack processing capability. Although most major meat packers will be heavily damaged, the capacity of the remaining plants can be expanded considerably by eliminating certain processing steps, and within six weeks after the attack these plants could fill about 85 percent of the Colorado Springs host-area emergency consumption requirements for meat.

As in other areas, the single commodity in shortest supply following the postulated attack will be fluid milk. Heavy damage to local milk processors will cause severe shortages of milk to persist for several months following an attack. However, since most of the dairy herd will still continue to be productive, production of evaporated milk could be increased and fresh milk could be shipped out of the state for drying and returned for use within Colorado. Milk could also be purchased directly from host-area dairy farmers. Even taking into account these and other alternative courses of action, however, it is unlikely that preattack consumption levels of fluid milk would be attained at any time during the first postattack year.

Heavy damage to Colorado flour mills and bakeries will cause shortages of baked products during the first year following an attack. Overall U.S. milling and baking capacity survival is much greater than that for Colorado, and local shortages could be alleviated somewhat by shipments of flour products from outside the state. In addition, the cereal shortage during the immediate postattack period can be offset by releasing a portion of Colorado's grain reserves to mass-feeding facilities.

Colorado storage facilities for such raw products as wheat and potatoes are generally located outside the major risk areas, and will survive with little damage. Major wholesale distribution facilities, on the other hand, which are located mainly in Denver, will be very heavily damaged by blast and fire. Only an estimated 5 percent of Colorado's wholesale food distribution warehouse capacity would survive the postulated attack. The throughput of these surviving wholesalers might be increased 50 percent within ten days following the attack. Warehouse space equivalent to an additional 12% of preattack capacity is available in buildings located in Larimer County. The remaining distribution capacity required to support the flow of food to Colorado Springs survivors will have to come from commandeered space or the construction of emergency warehouses.

POSTATTACK SYSTEM FLEXIBILITY

In the long run, both the national food distribution system and its local Colorado extension appear to be sufficiently flexible to adapt to a wide range of postattack conditions. However, neither the national nor the local system as currently constituted can be altered as quickly as immediate postattack conditions might warrant.

Supply

At the supply end of the distribution system, aggregate production during the first postattack year is likely to fall short of demand if the attack has been preceded by a successful evacuation. However, surviving stockpiles of grain may be substituted for less plentiful products. Even so, geographic supply/demand imbalances are almost certain to exist, so that stockpiles of non-perishable commodities in each low-risk host area appear to offer the only practical insurance against a loss of supply at the local level during the immediate postattack period.

Processing

The overall survival rate of the food processing industry is roughly half that of the national population under a strategy of crisis relocation. Local dairies and bakeries are particularly vulnerable to population-based attacks. Postattack food-processing capacity will be enhanced by the ability of many surviving plants (dairies and bakeries included) to expand their output beyond preattack levels by simplifying processing methods, by increasing employment or the number of shifts worked, or by relaxing quality control tolerances. Under certain circumstances, abandoned facilities or closely-related technologies may be converted to food processing following an attack. For instance, feed mills could be converted to whole-wheat flour production. For any food that can be distributed in its raw form -- and most foods can -- food processing capability should never be allowed to become a serious distribution bottleneck following an attack.

Distribution

At the local level, postattack distribution problems pose the most serious potential constriction in the food supply channel. Host-area retailers will need to be resupplied within 14 days after the attack, and mass feeding centers will need to be resupplied almost immediately. However, the primary preattack source of supply for these outlets, the risk-area wholesaler, will suffer heavy attack damage. After roughly ten days, surviving wholesale warehouses could increase their throughput by about 50 percent. A similar delay could be incurred before unused commercial space could be converted effectively to postattack warehousing. At least four to eight weeks will be required before emergency warehouses can be constructed to support any demand not met by warehouse expansion and space conversion. During this period, substantial supplies of food will have to be channeled through mass-feeding centers or emergency supply depots.

Although the need for mass-feeding programs may not extend more than one month beyond the attack date, there seems to be a significant probability that such programs will be needed and that the need will be critical from the standpoint of both morale and nourishment. If this need is to be met effectively in the immediate postattack period, a corresponding need for training recruits and planning mass-feeding operations must be met well in advance of any attack.

IMPLICATIONS OF POSTATTACK RESEARCH ON CRISIS RELOCATION GUIDANCE

The results of the postattack research in the Colorado Springs study area have been reviewed in light of the current guidance for crisis relocation planning. As a result of this review, it appeared that the basic strategy proposed for food distribution under crisis relocation conditions was sound, even though the continued use of risk-area warehouses left this element of the distribution system vulnerable to attack. However, the analysis accompanying the damage assessment and evaluation procedures brought to light several elements which should be included in the crisis relocation guidance issued by the federal government and in the crisis relocation plans for a specific area. These elements include:

1. Provision for identifying critical stockpiles of food held outside the normal distribution channels within the risk area and moving these stockpiles to the host area;

2. Provision for identifying host-area buildings which might be converted to food warehouses under emergency conditions and estimating the utility of such converted space;

3. Guidelines for expanding the capacity of existing food processing plants and converting the capacity of other plants to expand the production of critical commodities under crisis relocation conditions; and

4. Guidelines for anticipating postattack shortages of specific commodities and adjusting priorities for shipments during the crisis relocation period accordingly.

These elements, along with general postattack guidance for food decontamization and distribution, have been incorporated in prototype crisis relocation plans for the State of Colorado, the risk area of El Paso County, and a sample host area, Fremont County. Guidelines for state and local relocation planners have been updated to reflect these elements, as well as other concerns identified in extensive interviews with planners and industry personnel.

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EFFECTS OF ATTACK ON FOOD DISTRIBUTION TO THE RELOCATED POPULATION

VOLUME I: ANALYSIS AND CASE STUDY

1. INTRODUCTION

1.1 BACKGROUND

The all-hazard, all-contingency civil preparedness program now under study by the Defense Civil Preparedness Agency (DCPA) recognizes two basic strategies for protecting populations threatened by major hazards:

> One is to provide the best protection possible with the population essentially in place, at or near their homes, schools, and places of work. The second is for people to leave the threatened area if time allows (Reference 1).

While the strategy of protection in place remains the primary strategy for defense under nuclear attack conditions, the all-hazard, all-contingency civil preparedness program recognizes the need to plan for the contingency of relocating the population from high-risk areas during periods of severe international crisis. Four primary arguments support the need to plan for crisis relocation:

- It is probable that a nuclear attack upon the United States will be preceded by a crisis build-up of sufficient duration to permit population relocation from high-risk areas.

- If an adversary's cities were to be evacuated during a period of crisis, United States cities should also be evacuated.

- It is likely that many citizens will leave large cities in the face of crisis in a "spontaneous evacuation," whether or not they are advised to do so.

- Crisis relocation has been proven feasible in recent large-scale evacuations in the face of hurricane warnings.

The movement of large masses of population in advance of a threatened attack will severely test the flexibility of local and national food distribution systems. Past research undertaken by SYSTAN (Reference 2) has assessed the food requirements of the relocated populations, identified promising means of reconfiguring the existing food distribution system to meet these requirements, and developed and documented guidelines for food distribution under crisis relocation conditions. The current study extends the previous research by (1) investigating the effects of a nuclear attack on the reconfigured food distribution system and the relocated population, (2) identifying and evaluating alternative means of providing food to the relocated population following such an attack, and (3) reviewing existing crisis relocation guidance in the light of probable postattack consequences. This research quantifies the problem of providing food support for relocated populations following a nuclear attack, and systematically proposes and evaluates alternative

solutions to this problem. Where applicable, the proposed solutions are examined in detail in a case study of Colorado Springs, Colorado.

1.2 OBJECTIVES

The general objective of the research described in this report has been "to analyze the effects of an attack on this food system and determine the consequences for the relocated population." Specific contractual tasks have been to:

1. "Investigate alternate ways of providing supplies of food to these populations for the period extending through the attack, postattack and recovery period.

2. "On the basis of results obtained from this analysis, prepare a set of planning guidelines and prototype food supply plans for the period of attack and postattack following a crisis relocation. These plans should naturally follow the ones prepared for the crisis period and should be in a form readily adaptable for incorporation in the overall crisis relocation plans.

3. "Field test the planning guidelines and food prototype plans prepared under (2) above and show how these tests help validate the plans in order to make them more acceptable and readily adaptable for CRP trans- and postattack conditions."

Task 1 is the subject of Volume I of this report (Chapters 1 through 6). Volume II contains one of the products of Task 2, the planning guidelines; and Volume III contains the other Task 2 product, the prototype food supply plans. Chapter 7 of Volume I describes the field tests of guidelines and food prototype plans undertaken as part of Task 3.

1.3 REPORT ORGANIZATION

Chapter 2 of this report summarizes SYSTAN's guidelines for reconfiguring the existing food distribution system under crisis relocation conditions, reviews past research in postattack food distribution and discusses the implications of this research on the problem of estimating the effects of an attack on a reconfigured food distribution network designed to serve a relocated population. Chapter 3 describes normal and emergency food distribution patterns in Colorado Springs. The flow of individual commodities is traced through the distribution network from producer to consumer, and data are assembled describing the location and vulnerability of food stocks within that network. To provide a basis for assessing the probable postattack adequacy of the reconfigured food distribution system in the sample city, a hypothetical attack was postulated and each element of the distribution system underwent a

damage assessment analysis. The results of this damage assessment appear in Chapter 4. These results were applied to the preattack commodity-flow model to predict the probable postattack flow of the selected food groups to host-area survivors. Alternative postattack distribution strategies capable of meeting the nutritional requirements based on USDA National Emergency Consumption Standards were identified and evaluated. Chapter 5 summarizes promising strategies for postattack food distribution and discusses the implications of these strategies on crisis relocation planning activities.

2. PAST RESEARCH AND CURRENT EMERGENCY PLANNING

Past research into food distribution under emergency conditions has outlined the current food distribution network in the United States, investigated the probable implications of a nuclear attack on that network, and suggested promising means of reconfiguring the existing distribution network to meet the needs of populations evacuated from central cities under a crisis relocation strategy. This section summarizes the findings of previous research in postattack food distribution, and discusses the implications of these findings on the problem of estimating the effects of an attack on a reconfigured food distribution network designed to serve a relocated population.

2.1 OVERVIEW OF EXISTING FOOD DISTRIBUTION SYSTEM

Exhibit 2.1 depicts the major elements of the U.S. food distribution system, reflects the national, regional and local character of these elements, and indicates the approximate vulnerability of these elements to nuclear attack relative to their location in designated risk areas.[1] Retail food outlets tend to be distributed in accordance with the consuming population, and hence are a ubiquitous element within the local food distribution system. Wholesale distribution warehouses are regional in scope, and are generally located in large population centers, which are also designated as high-risk target areas. Food processors are both national and regional in character; sugar refineries and yeast manufacturing plants are examples of processors that typically produce for a national market, while bakeries and dairies tend to concentrate on regional or even local markets. In the case of most U.S. agricultural commodities, production tends to be concentrated in a few large producing areas serving national markets. Although the producing areas are generally located outside high-risk areas, this concentration leads to significant production/consumption imbalances at the local and regional levels. To illustrate the relative magnitude of this imbalance, a prior study of agricultural vulnerability to nuclear attack noted that the Pacific Northwest region of the United States (Washington, Oregon, Idaho and Montana) produced enough food to feed five times the region's population, while the Northeast region (New York, New Jersey and the six New England states) produced only enough food to feed two out of thirteen of its residents.

Those elements of the distribution that would bear the brunt of demand immediately before and after a crisis are those elements nearest the consumer: food inventories held by wholesalers, retailers and the consumers themselves. These elements of the system tend to be distributed evenly with regional population patterns, and are less subject to

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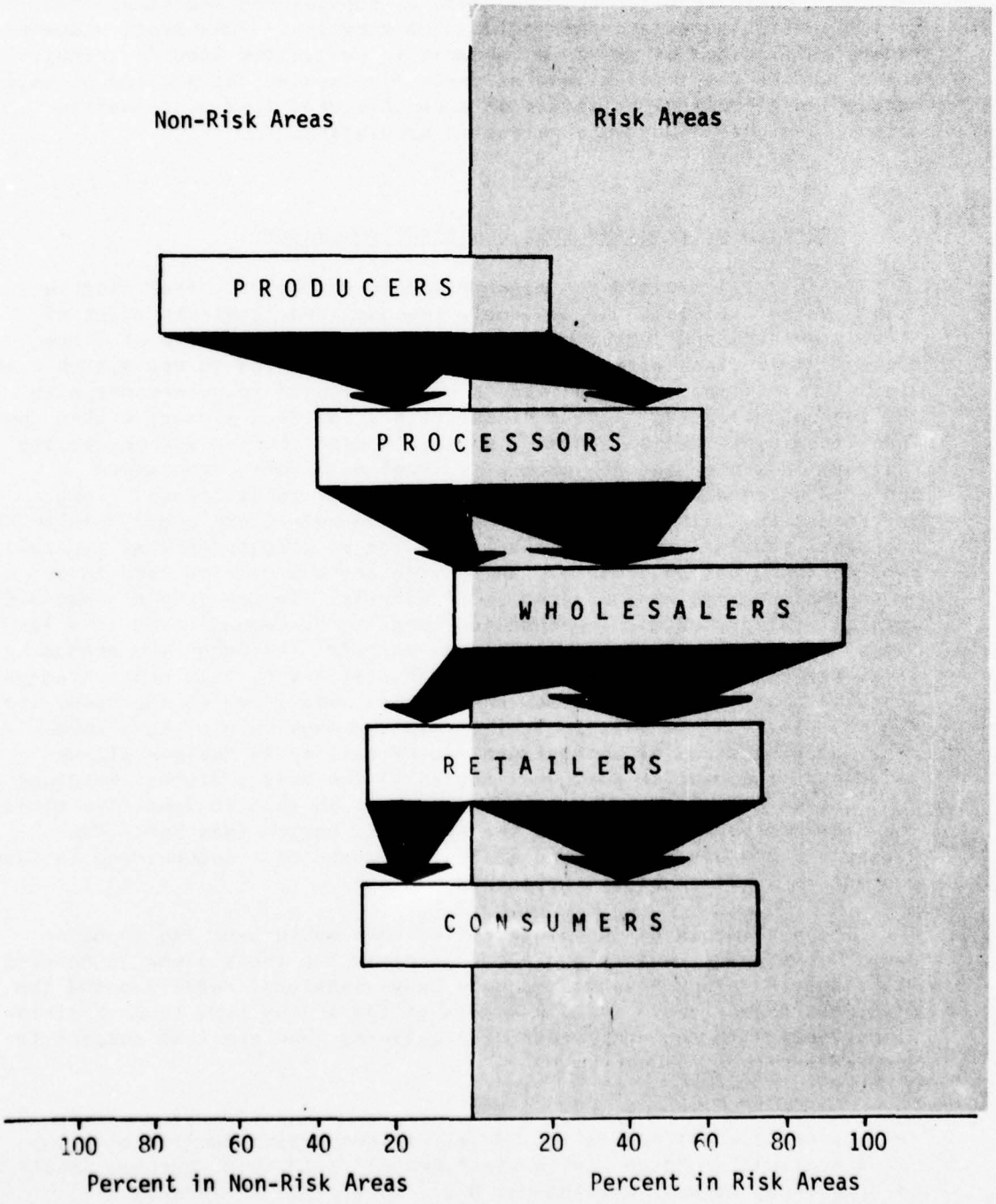
[1]Risk areas are defined to include all target areas identified in the DCPA publication "High Risk Areas," Report TR-82, U.S. Defense Civil Preparedness Agency, Washington, D.C., April 1975 (Reference 3).

EXHIBIT 2.1

PRINCIPAL ELEMENTS OF THE FOOD DISTRIBUTION SYSTEM



the geographic imbalances that mark the food production and processing system. Using normal consumption rates as an index, U.S. grocery wholesalers typically maintain between one and one-half and four weeks of inventory. The lower end of this range of inventory levels reflects the performance of a chain store operation serving a limited geographic area, while the upper limit of four weeks is more characteristic of an independent wholesaler serving clients scattered over a wide area. Retailers typically maintain between one and three weeks of inventory, with the level of any specific commodity being inversely related to its perishability and demand. In addition to stock on the shelves of wholesalers and retailers, an additional seven to ten days of supplies are estimated to be in transit to wholesale warehouses at any time. Furthermore, consumers have estimated that food stocks on hand could be made to last between one and two weeks in time of emergency. Taking the most conservative estimates of inventories available on the shelves of wholesalers, retailers and consumers, then, it can be estimated that a minimum of three weeks of food supplies will be available at the regional level at any time, with an additional week of supplies in transit. Whereas retail stocks and home stocks are readily available to the consumer, wholesale stocks tend to be held in regional distribution centers located within the nation's largest cities. Nearly two-thirds of the urbanized risk areas scheduled for evacuation under a crisis relocation strategy rely on other metropolitan areas for at least 50% of their wholesale food supplies. Food stockpiles under federal control are insignificant. More details regarding the nature and capabilities of the nation's existing food distribution network may be found in References 2 and 5.

2.2 SUMMARY OF PRIOR POSTATTACK RESEARCH

Past research into the problems of feeding the surviving populations in a postattack environment has focused almost exclusively on existing channels of distribution, without considering any alterations in those channels which might be necessary to support a crisis relocation strategy. The earliest investigations of these problems studied the nationwide availability of food supplies and were concerned primarily with the total calorie content of national food stocks (References 6, 7, 8 and 9). Although these nationwide calorie-counting expeditions provided a generally reassuring picture of national food survival, they were not sufficiently detailed to detect either local food shortages or nutritional imbalances in areas top-heavy with calories provided by a single commodity.

In 1965, in an effort to resolve the many unanswered questions regarding local postattack commodity distribution, Stanford Research Institute undertook a detailed, commodity-by-commodity investigation of food distribution in the three cities of San Jose, Albuquerque and Detroit (References 10, 11 and 12). These studies revealed that significant supply/demand imbalances could be anticipated at the local level following a nuclear attack, and that damage to the local distribution system could severely restrict the flow of foodstuffs during the immedi-

ate postattack period. Concurrent studies (References 4 and 13) emphasized regional supply-demand imbalances and, hence, the importance of the national and local food distribution systems in postattack recovery. A recent comprehensive study of potential postattack problems identified wholesale food warehouses as the most vulnerable point in the local distribution chain and concluded that food distribution breakdowns posed one of the most serious threats to population survival during the postattack period (Reference 14).

Thus, past research has highlighted two major problem areas likely to be encountered in postattack food distribution:

1. Geographic supply/demand imbalances; and

2. Local distribution breakdowns.

The likely impact of an attack on each element of the existing food distribution chain from producer to consumer is summarized in the following subsections.

2.2.1 Agricultural Producers

The majority of the nation's agricultural production capability is expected to survive a nuclear attack However, fallout radiation could substantially reduce yields, depending upon the season (Reference 15).

2.2.2 Raw Food Reserves

Surviving national reserves of grains and other unprocessed food, such as potatoes and apples in cold storage, could provide emergency rations to survivors for a considerable period, so immediate postattack farm production is not critical for most items. From 1954 to 1971, the total quantity of grain in storage in the United States always exceeded the annual consumption level. As grain exports increased markedly in the early 1970's, carryover wheat storage levels at the end of the harvest year dropped below annual consumption levels. Even so, the quantities in all years have been sufficient to last for a considerable time (at least six months) in periods of emergency. Since the crop year 1975/76, moreover, carryover storage levels have exceeded annual domestic consumption rates by a comfortable margin. Other recent trends in wheat storage include a decline in federally-held wheat stocks and a relative increase in the amount of wheat held on farms.

Nearly all the grain stored on farms and 50-70% of that stored off farms, depending on the season, would not be affected by the blast and fire of a nuclear attack. Grain stored off farms is distributed among local town and county elevators, warehouses, processing plants, and large central terminals. Many processing plants and large terminals would be destroyed by an attack, but the bulk of off-farm storage is in

the local elevators in small towns which would not be substantially affected by the blast and fire of an attack on major urban centers.

2.2.3 Food Processors

The food processing industry is widely dispersed throughout the country, but some of it is located in or near major cities. According to a recent study by the Federal Preparedness Agency (Reference 42), approximately 60% of the U.S. food processing industry could be destroyed by an attack. Under emergency conditions, however, most foods can be eaten partially processed or without processing. For example, wheat grain, which is extensively stockpiled, can be boiled and eaten as porridge without processing.

2.2.4 Food Wholesalers

The general element of the food distribution system that is most vulnerable to nuclear attack is the regional and local food wholesaler. One recent nationwide assessment of the damage caused by a hypothetical attack showed that the percentage of surviving population, even in the absence of crisis relocation measures, exceeded the percentage of remaining food warehouses by a substantial margin (Reference 14).

Dense clustering of food warehouses in targeted trade centers accounted for this imbalance, which was even more pronounced at the local level in the larger cities. The details of the study revealed serious postattack problems at the wholesale distribution level in most large U.S. cities. The loss of food wholesalers in these cities results not only in the deterioration of the inventories available within a locality immediately after an attack, but also in the loss of a critical staging element in the distribution process.

2.2.5 Food Retailers

Retail food stores are distributed in much the same pattern as the population itself. In the absence of population evacuations, therefore, most postattack studies have assumed that the retail system survives in direct proportion to population survival.

2.3 CURRENT USDA EMERGENCY PLANNING

Recognizing the importance of food in postattack recovery, the U.S. Department of Agriculture (USDA) has developed an emergency food management program to provide regulatory guidelines for the orderly processing, storage, and wholesale distribution of food in case of a nuclear attack. This is a national program capable of being administered

locally through an emergency organization of state and county defense boards. The details of the USDA's food management program are set down in Defense Food Order No. 2 (Reference 17). Defense Food Order No. 2 is intended for postattack application, and is not expected to be in effect during crisis relocation. Appendix B of this report contains a detailed discussion of the USDA's current position regarding preattack activities in the event of a crisis relocation.

The general intent of the regulatory guidelines contained in Defense Food Order No. 2 is to allow existing processors, wholesalers, and retailers to continue to function following an attack in a manner that closely approximates their preattack operations, subject to such direction and controls as are required by postattack circumstances. The Order requires processors and distributors:

1. To continue to serve their regular customers, if possible, and any others that may be assigned to them;

2. To comply with such postattack suborders as apply to them; and

3. To set aside a portion of their goods for procurement by the Armed Forces (if they supplied the Armed Forces during the preattack period).

2.3.1 Immediate Postattack Action

Defense Food Order No. 2 states the basic rules governing the restrictions on the processing, storage, and wholesale distribution of food. In the present updated version of this document, the policy of the U.S. Department of Agriculture (USDA) is to maintain close coordination with state and local governments and to administer Defense Food Order No. 2, insofar as feasible, so as to minimize the effect of restrictions imposed by the Order upon the processing, storage, and wholesale distribution within trade channels. Defense Food Order No. 2 was revised on October 1, 1976 to reflect current USDA thinking regarding emergency food distribution. Whereas previous versions of this Order had contemplated the imposition of temporary postattack freeze orders on retail sales, the most recent version anticipates no national freeze orders at the retail level.

Unlike previous versions of Defense Food Order No. 2, there is now no specific limit on distribution, except that the allowances in the National Emergency Maximum Food Distribution Allowance may not be exceeded. Specifically, the Order states that the Order Administrator may (among other things): (1) place appropriate conditions on the processing, storage, and wholesale distribution of food, including the quantity of agricultural products which may be used for processing; and (2) establish a maximum food distribution allowance for civilians and prohibit the distribution of food for civilians in excess of this allowance.

2.3.2 Continuing Postattack Action

When the resumption of transportation and communications allows better flow of food supplies, flow will be redirected in a manner that alleviates shortages and provides for a continuing supply of food throughout the United States.

Defense Food Order No. 2 makes no specific allowances for a crisis relocation strategy or for the control of a distribution system reconfigured in support of such a strategy. As a previous report has noted, "Defense Food Order No. 2 can be expected to function efficiently as long as the survival of food distribution facilities approximates population survival. If citizens out-survive distribution facilities in a manner that creates severe supply/demand imbalances in a number of localities, both the surviving distribution system and USDA's Order Administrators will have to scramble to match supply with demand in the critical emergency period. The continued feeding of survivors in areas subject to such imbalance may require rapid, significant departures from preattack food distribution patterns at both local and national levels" (Reference 12).

2.4 FOOD DISTRIBUTION UNDER CRISIS RELOCATION CONDITIONS

The DCPA strategy of relocating the population from areas of high risk during periods of severe international crisis can significantly increase the expected number of survivors if the crisis leads to an all-out nuclear exchange. Studies have shown that a successful crisis relocation strategy might save an additional 70 million lives over the number saved by a strategy of in-place protection (Reference 16). The movement of large masses of population in advance of a threatened attack will severely test the flexibility of local and national food distribution systems. Past research (Reference 2) has assessed the food requirements of the relocated populations, identified promising means of reconfiguring the existing food distribution system to meet these requirements, and developed and documented guidelines for food distribution under crisis relocation conditions.

Exhibit 2.2 summarizes the general guidelines for food distribution under crisis relocation conditions that have evolved from past research efforts. These guidelines identify activities at the state and regional level as well as activities in the risk area being evacuated and the host area receiving evacuees. The regional nature of the nation's food distribution system makes it imperative that plans for redirecting this system in times of emergency be prepared at the state or regional level. Planning efforts undertaken at this level should include the redirection of normal supply channels to the host areas and the reallocation of transportation drivers and equipment needed to support this redirection. State officials should also rescind all state regulatory restrictions (e.g., highway weight limitations) which might inhibit the redirection of supplies under emergency conditions.

EXHIBIT 2.2: RECOMMENDED GENERAL GUIDELINES FOR PROVIDING FOOD SUPPORT FOR THE CRISIS RELOCATION STRATEGY

STATE AND REGIONAL ACTIVITIES

- Define distribution patterns for chain and independent wholesalers.
- Arrange for any additional drivers and equipment made necessary by revised distribution patterns through NDTA.
- Waive vehicle highway weight restrictions.
- Publicize waiving of DOT Driver Restrictions.

	RISK AREA ACTIVITIES	HOST AREA ACTIVITIES
PRODUCERS	• Continue any agricultural activity of national, regional, or local significance. (Little significant agricultural production currently occurs in risk areas.)	• Continue all agricultural activity.
PROCESSORS	• Continue only those processing activities that lead to production of commodities included in emergency standards and that either are national or regional in scope or command a significant share of the local market. • Encourage workers in discontinued processing activities to transfer their skills to similar host area processing facilities.	• Continue all food processing activity, expanding operations where possible through the use of relocated workers and unused capacity.
WHOLESALERS	• Continue to operate all chain and independent wholesale operations that command a significant share of the local market, or that prefer to remain open, following revised distribution patterns specified at state and regional level. • Empty remaining small warehouses as quickly as possible, transferring goods to host area commissaries and warehouses. Encourage workers in discontinued operations to seek employment in host area warehouses. • Augment transportation fleet and driver pool as required, following guidelines and procedures established by NDTA for obtaining personnel and equipment from other sectors. • Increase vehicle and driver productivity by taking advantage of waived driver restrictions and weight limitations; minimizing down-time; relaxing maintenance requirements; increasing vehicle loads; loading only full-pallet quantities; and shipping only necessary commodities.	• Continue all food warehousing and distribution activities, expanding operations where possible through the use of commandeered space, worker overtime, and relocated workers. • Augment transportation fleet and driver pool as required, following guidelines and procedures established by NDTA for obtaining personnel and new equipment from other sectors. • Increase vehicle and driver productivity by taking advantage of waived driver restrictions and weight limitations; minimizing down time; relaxing maintenance requirements; increasing vehicle loads; loading only-full pallet quantities; and shipping only necessary commodities.
RETAILERS	• Observe any price controls & single-purchase limitations established nationally during pre-crisis period and evacuation period. • As inventories & personnel permit, remain open during evacuation period. Then close operations for duration of crisis relocation period & report on remaining inventories. • Chain stores arrange for employees to transfer to chain's host area outlets for duration of emergency. Employees of independent stores should be encouraged to seek employment in host area retail outlets.	• Observe any price controls, single-purchase limitations, rationing plans, & coupon redemption policies established nationally during pre-crisis period & for duration of crisis relocation period. • Continue all retail food operations, expanding as required by using added personnel relocated from risk area; extending business hours; authorizing overtime work; stocking at night; and identifying and using expedient nearby storage space.
PREPARERS AND SERVERS	• Chain restaurants with host area outlets should transport inventories to these outlets & reassign workers to host area operations. • Fast food operations should prepare as many meals as possible during evacuation period & make them available at evacuation staging area. • Caterers should relocate all mobile food preparation equipment & as much of their inventories as possible to host area. • Institutions & stores with equipment for large-scale food preparation should transport inventories & equipment to host area.	• Restaurants & kitchen-equipped institutions should expand operations by using additional personnel relocated from risk area; enlarging seating capacity; & identifying & using expedient nearby storage space (garages, etc • Large-scale mass feeding operations in kitchen-equipped institutions will be supervised by disaster agencies such as Red Cross • Distribute food preparation equipment & incoming inventories as needed among institutions, restaurants, congregate care facilities, & private residences with hosting capacity.
CONSUMERS	• Avoid hoarding in pre-crisis period. • Transport as much non-perishable food to host area as is permitted by home stocks and mode of transportation. A one- to two-week supply should suffice.	• Avoid hoarding in pre-crisis period. • Encourage host area residents to provide shelter and food to members of relocated population.
CONTROLS	• Price regulation & liberal single-purchase limitations at retail outlets during pre-crisis and evacuation periods.	• Price regulation & conservative single-purchase limitations at retail outlets during pre-crisis period. • Price regulation & coupon rationing at retail outlets, restaurants, & mass feeding facilities during crisis relocation.

Exhibit 2.2 also summarizes the suggested activities to be undertaken by risk area and host area food producers, processors, wholesalers, retailers, preparers, servers and consumers during a crisis relocation. For all elements of the food distribution at the wholesale level and above, these activities have been designed to parallel normal distribution activities as closely as possible. A conceptual view of the flow of food under crisis relocation conditions appears in Exhibit 2.3. Extensive research and discussions with food industry personnel have led to the conclusion that the most effective strategy for food distribution under crisis relocation conditions is to allow agricultural production and the output of major processing plants to follow normal channels and to continue using risk area wholesale facilities to serve the evacuated population. As indicated in Exhibit 2.3, these wholesale facilities would provide a highly-increased level of service to those retail stores located in outlying host areas.

The proposed distribution adjustments outlined in the guidelines of Exhibit 2.2 and depicted conceptually in Exhibit 2.3 have many attractive features: The altered system is conceptually simple, and builds intelligently on the existing system without creating new operating entities. Corporate chains are preserved as distribution units, and most host area retail stores will continue to be supplied by their pree-vacuation sources. Strains on the national distribution system is minimized and supplies on the road from national processors to regional and local wholesalers at the time of evacuation need not be rerouted.

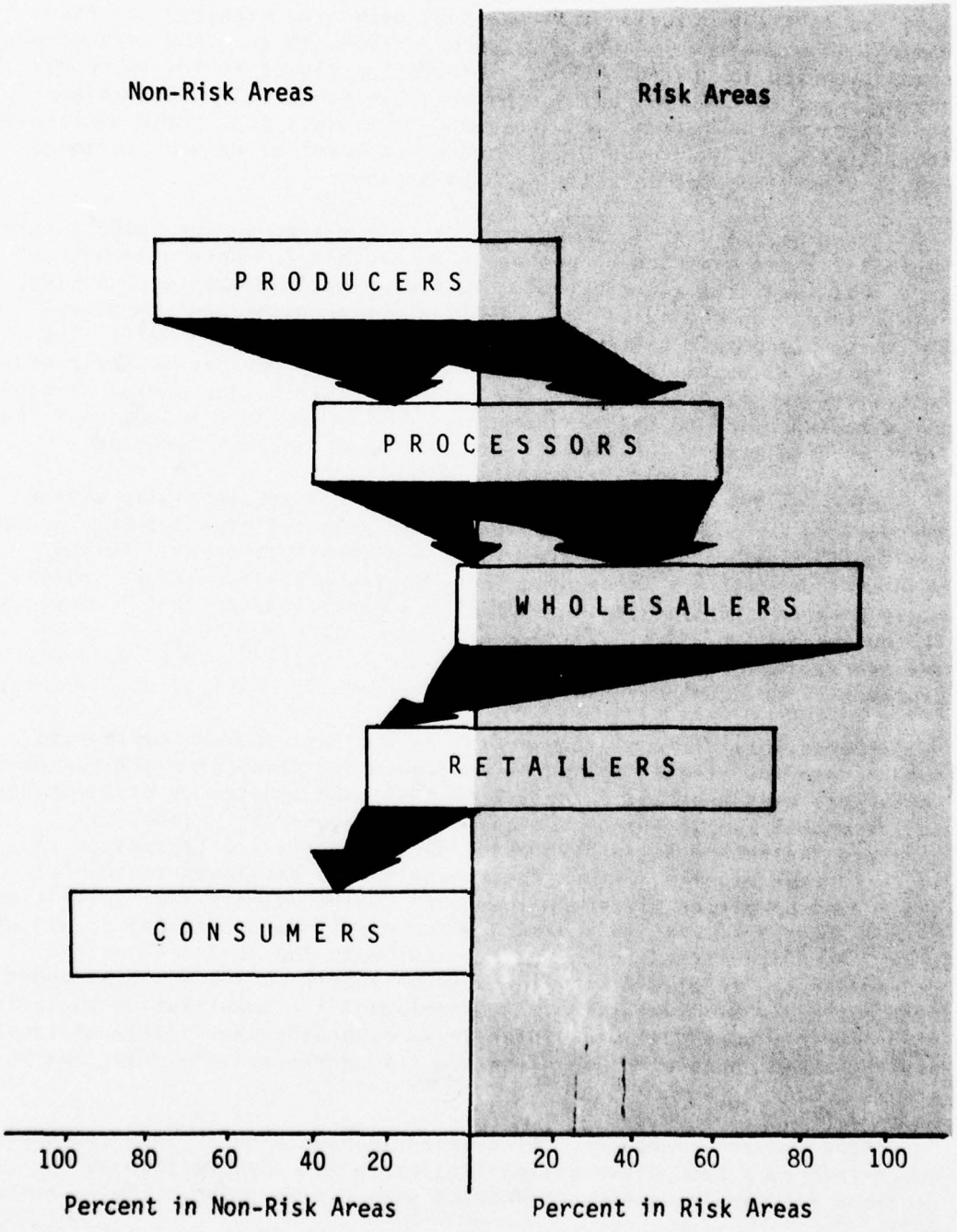
Although the proposed adjustments would not substantially change the national channels of distribution supplying the risk and host areas, the local distribution system would be drastically altered. Certain points of stress in the adjusted local distribution system are immediately apparent. In addition to placing a heavy load on retail stores in the outlying host areas, the adjusted system greatly increases local transportation requirements. The distance traveled by local delivery trucks will be substantially increased by massive population movements.

The ability of local transportation and distribution systems to accommodate the stress imposed by continued operation of risk-area warehouses has been analyzed in detail in past case studies of crisis relocation undertaken in Detroit, Michigan (Reference 12), Richmond, Virginia (Reference 5), and Colorado Springs, Colorado (Reference 2). In these past studies, mathematical models were developed to quantify the amount of stress placed on the local distribution system by an evacuation process of specified distance and magnitude. Critical points of stress were identified and quantified for both the host-area retail stores and the local distribution systems supplying these stores under a strategy of crisis evacuation. To supplement the quantitative analysis, food industry personnel were interviewed regarding the ability of local retailers and wholesalers to withstand transportation and distribution stress.

Food industry personnel interviewed in past studies have overwhelmingly favored a food distribution strategy which enables them to continue to operate warehouses located within risk areas. Their assess-

EXHIBIT 2.3

FOOD DISTRIBUTION UNDER CRISIS RELOCATION STRATEGY



ments also support quantitative research indicating that host-area retail outlets are capable of withstanding the stresses imposed by such a strategy. The ability of the local transportation system to withstand the stress imposed by increased vehicle mileage emerges as the most critical element in determining the success of a strategy entailing the continued operation of risk-area warehouses. Food industry leaders estimate that a doubling of vehicle mileage may be tolerated for short periods (one to two weeks) without requiring additional equipment. More detailed discussions regarding the level of transportation stress imposed by a strategy of continuing risk-area warehouse operations may be found in Billheimer, et al. (Reference 2) along with an analysis of different measures for alleviating this stress. In spite of the additional stress imposed on the transportation system, the continued operation of major risk-area wholesalers is preferable to the alternative strategies considered for staging and transporting food to host areas: Pre-crisis stockpiling is too costly on a nationwide scale; direct shipments from processors to the host areas would disrupt existing channels and require impossible priority judgments; and heavy use of expedient host-area warehouse space is both inefficient and difficult to accomplish within a one-week time frame. Other distribution alternatives to be avoided under crisis relocation conditions include the disruption of orderly production and processing channels (by raiding graneries or ad hoc cattle slaughtering), the scavenging of insignificant risk-area inventories following evacuation, and the imposition of flow restrictions at the wholesale level. The purpose of flow restrictions, such as those once proposed in Defense Food Order 2 (see Subsection 2.3.1) under postattack conditions at processor and wholesaler levels (Reference 17), is to conserve scarce resources and to permit the redirection of inventories to areas with damaged supply chains. While such flow restrictions may be appropriate in a postattack environment, they are totally inappropriate under crisis relocation conditions. The chief purpose of a crisis relocation strategy is to reduce the vulnerability of the citizenry by eliminating dense population concentrations and removing individuals from target areas. The vulnerability of the nation's food stocks will be similarly reduced by removing stocks from risk areas and spreading them among host-area distribution centers. Accordingly, the flow of food stocks should not be restricted under crisis relocation conditions. Rather, the flow of food from risk areas to host areas should be increased and expedited whenever possible.

2.5 IMPLICATIONS OF PAST RESEARCH

Past research into food distribution under emergency conditions has traced the existing food distribution network, investigated postattack food availability and accessibility under a strategy of in-place protection, and suggested promising means of reconfiguring the existing distribution network to meet the needs of populations evacuated from central cities under a crisis relocation strategy. A review of this research suggests that the two most serious distribution problems identified following an attack on an unevacuated population are likely to be intensified by a strategy of crisis relocation. The survival of addi-

tional people in areas removed from traditional distribution centers can be expected to intensify the stress imposed on the damaged transportation system by the geographic separation between remaining food stocks and the surviving population. Furthermore, the guidelines for food distribution under crisis relocation conditions rely heavily on the continued operation of the most vulnerable element of the local distribution system, the risk-area wholesale warehouse. The loss of these warehouses in an attack will remove both important food inventories and a crucial staging element in the distribution system relied upon by an increased number of survivors in host areas.

2.6 CURRENT RESEARCH APPROACH

To assess the impacts of nuclear attack on a reconfigured distribution network under a crisis relocation strategy, the current investigation has developed a quantitative picture of food distribution networks serving a sample study area: Colorado Springs, Colorado. Supplies in the food distribution network have been traced from producer to consumer, and the location and size of inventories in each stage of the distribution network have been plotted on a commodity-by-commodity basis for the eight food roups of meat, milk, eggs, cereals and cereal products, fruits and vegetables, food fats and oils, potatoes, and sugar. To provide a basis for assessing the probable postattack adequacy of the reconfigured food distribution system in the sample city, a hypothetical nuclear attack was postulated, and each element of the distribution system from producer to consumer underwent a damage assessment analysis. The results of this damage assessment were applied to the preattack commodity-flow model to predict the probable postattack flow of the selected food groups to host-area survivors. The surviving distribution system was examined for bottlenecks that might be caused by losses in production capability, labor productivity, supply availability, warehousing space, and transportation accessibility. The postattack inventories derived in this manner were compared with the USDA's National Emergency Food Consumption Standards (see Section 4.1) to determine the degree to which supplies of the selected commodities could be expected to meet the requirements of survivors. Alternative postattack distribution strategies capable of meeting these requirements were postulated and evaluated, and promising strategies were examined for components which could be incorporated into the preattack guidance for the relocation effort. The following section traces the current food distribution network of the sample city of Colorado Springs and identifies the network changes imposed by a crisis relocation strategy, while Section 4 quantifies the damage imposed on the reconfigured network by a nuclear attack.

3. NORMAL AND EMERGENCY FOOD DISTRIBUTION PATTERNS IN COLORADO SPRINGS

This section describes the food distribution system serving Colorado Springs, Colorado, and the adjustments proposed for that system in the event of a massive evacuation. After summarizing the general adjustments required at the regional and local levels to support a crisis relocation strategy, the flow of individual food groups is traced through the distribution network from producer to consumer, and data are assembled describing the location and vulnerability of food stocks within that network.

3.1 OVERVIEW OF THE COLORADO SPRINGS STUDY AREA

By agreement between the Colorado Division of Military Affairs and the U.S. Defense Civil Preparedness Agency, the urbanized area of Colorado Springs has been designated as a target risk area in the event of a nuclear attack threat. The specific area designated to be at risk includes the urbanized area itself and the portion of El Paso County directly south of the urbanized area, including Cheyenne Mountain and the Fort Carson Military Reservation. Those portions of El Paso County north, east and west of the city limits -- including the U.S. Air Force Academy and the Pikes Peak, Monument and Elmore areas -- are judged to be at no risk.

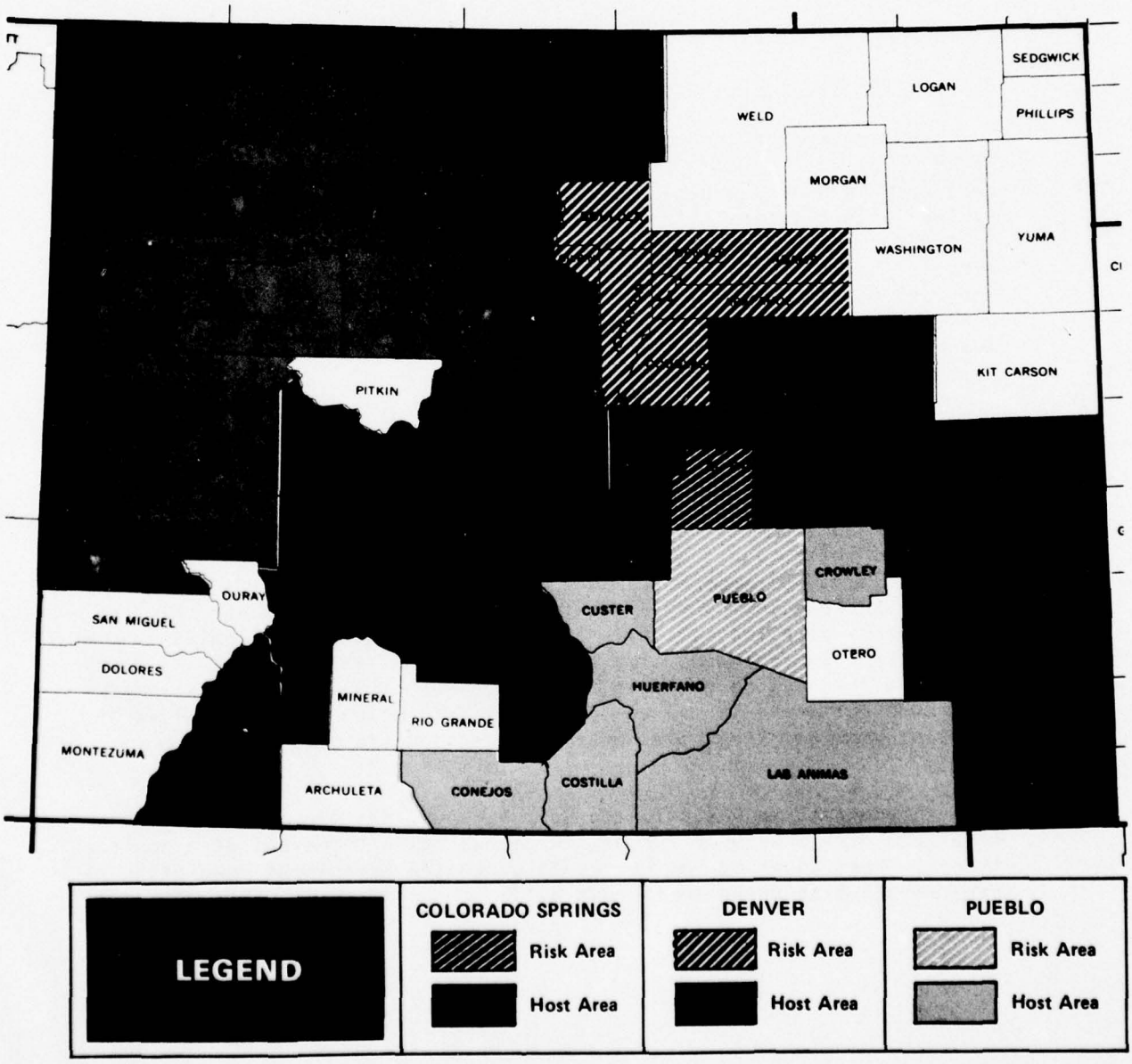
3.1.1 Evacuation Patterns

In conjunction with local officials, DCPA representatives have identified lower-risk areas in surrounding counties to which residents of the Colorado Springs area might be evacuated under threat of nuclear attack. Surrounding counties designated as host counties for Colorado Springs include Alamosa, Chaffee, Fremont, Gunnison, La Plata, Saguache and Teller. In addition, some rural areas of El Paso County will be available for hosting evacuees. The location of the Colorado Springs risk and host areas is mapped in Exhibit 3.1, which also identifies the resident population and the number of evacuees assigned to each host county.

In addition to the Colorado Springs area, the Denver and Pueblo areas are also scheduled for crisis elocation in the event of a nuclear threat. Host counties for residents evacuated from these population centers are also shown in Exhibit 3.1.

EXHIBIT 3.1

Colorado Risk and Host Areas



3.1.2 Key Assumptions

Several of the key assumptions made in developing a crisis relocation plan for Colorado Springs are listed below. These assumptions have been condensed from a longer list of premises appearing in a preliminary crisis relocation plan developed for the Colorado Springs area (Reference 19). Readers desiring more information on the assumptions underlying the crisis relocation, or the specific details of the Colorado Springs evacuation plan, are referred to this document.

1. Relocation of the risk-area population will occur only at the direction of the Governor of Colorado, generally at the request of the President of the United States. Measures preparatory to such relocation may be undertaken during a crisis at local option.

2. Crisis relocation of the risk-area population, when directed by the Governor of Colorado, will be mandatory -- not voluntary -- and in general accordance with the crisis relocation plan.

3. All of the risk-area population, less active-duty military personnel, will relocate to designated host counties or designated parts of El Paso County.

4. After relocation is accomplished, there will be no requirement for goods or services anywhere in the risk area during the relocation period, except as necessary for the preservation of property and the support of essential activities.

5. Some portion of the risk-area population, estimated at between 10 and 20 percent, can be expected to leave the area in advance of a directed crisis relocation. These spontaneous evacuees are expected to consist mainly of families whose members do not have public or emergency responsibilities and who have a acation home or relatives in mind as a destination. The location, identification, and destination of this group will not be known.

6. Once crisis relocation of the risk-area population has been directed, the minimum duration of the relocation period will be seven days. The maximum duration of the relocation period is uncertain, but could last several weeks.

3.2 OVERVIEW OF EXISTING FOOD DISTRIBUTION SYSTEM

3.2.1 Food Distribution Channels

Colorado Springs relies heavily on Denver for its supply of processed foodstuffs. Very little food is stored at wholesale warehouses within the city itself. The vast majority of the Colorado

Springs food supplies is shipped through Denver and warehoused in the larger city. Exhibits 3.2 and 3.3 illustrate tne importance of Denver as a food distribution center for Colorado Springs and the remainder of Colorado. Exhibit 3.2 traces the food flow through Denver itself, showing the mode of shipment and ultimate destination of food moving through Denver. Food destined for Colorado Springs represents less than 10 percent of the total amount of food moving through the Denver marketplace. Two-thirds of the food shipments reaching Denver arrive by truck. Movements from Denver to the Colorado Springs risk and host areas are made almost exclusively by truck. Most of these local movements take place in trucks that are owned and operated by supermarket chains and major independent wholesalers. A variety of truck types are used, but the predominant unit is a tractor-trailer combination with a 40,000 pound carrying capacity.

Four major firms are primarily responsible for retail food distribution in the Colorado Springs risk and host areas: Safeway Foods; the National Tea Company, which operates Miller's Supermarkets; the Dillon Company, which operates King Soopers; and Associated Grocers, which serves a number of independent retailers. Exhibit 3.3 identifies the relative market shares of these four major firms. The areas of the independent circles have been scaled in relation to the area of the circle representing the Colorado Springs supply. Thus, Safeway Foods accounts for 37.5% of Colorado Springs grocery supply, with 9.6% of the flow through its Denver warehouse. Similarly, King Soopers -- a subsidiary of Dillon Company -- accounts for 13% of the Colorado Springs food supply, with 7% of the flow through its Denver warehouse. Associated Grocers accounts for 36% of the food supply to independent Colorado Springs grocers and certain small chains, with 15.2% of the flow of food through its warehouses in Denver and Pueblo.

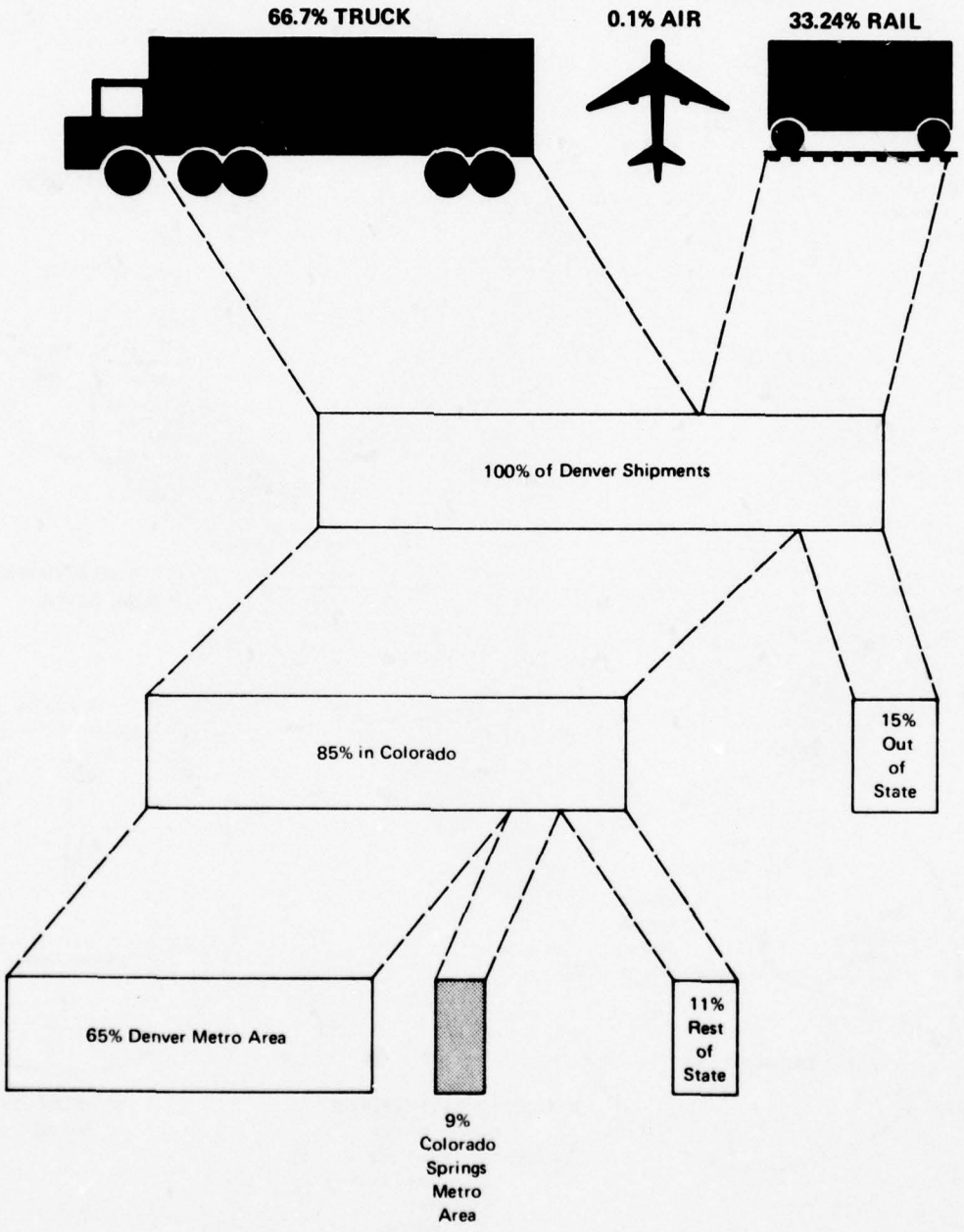
The food supply breakdown for the Colorado Springs risk area shown in Exhibit 3.3 was assembled by SYSTAN from published data and interviews with each of the major wholesalers serving the risk area (Reference 2). Host-area statistics were obtained from DCPA-sponsored surveys of retail food stores in each of the seven host-area counties. These statistics show that Safeway and Associated Grocers are the primary food distributors in the host-area counties. The Safeway chain accounts for an estimated 43% of retail food sales in the host area with six stores, while Associated Grocers serves 37 independent retailers accounting for 45% of host-area sales.

3.2.2 Local Food Production

Colorado Springs residents, who are dependent on wholesale food distribution centers located outside the boundaries of the risk and host areas, must also look outside these boundaries for food production resources. There is relatively little agricultural production within the risk and host areas. The sole instance of production on a large scale occurs in the case of the San Luis Valley potato crop. Storage stocks of this crop reach their high point in the San Luis Valley in December, and are generally depleted by mid-April. Recent storage

EXHIBIT 3.2

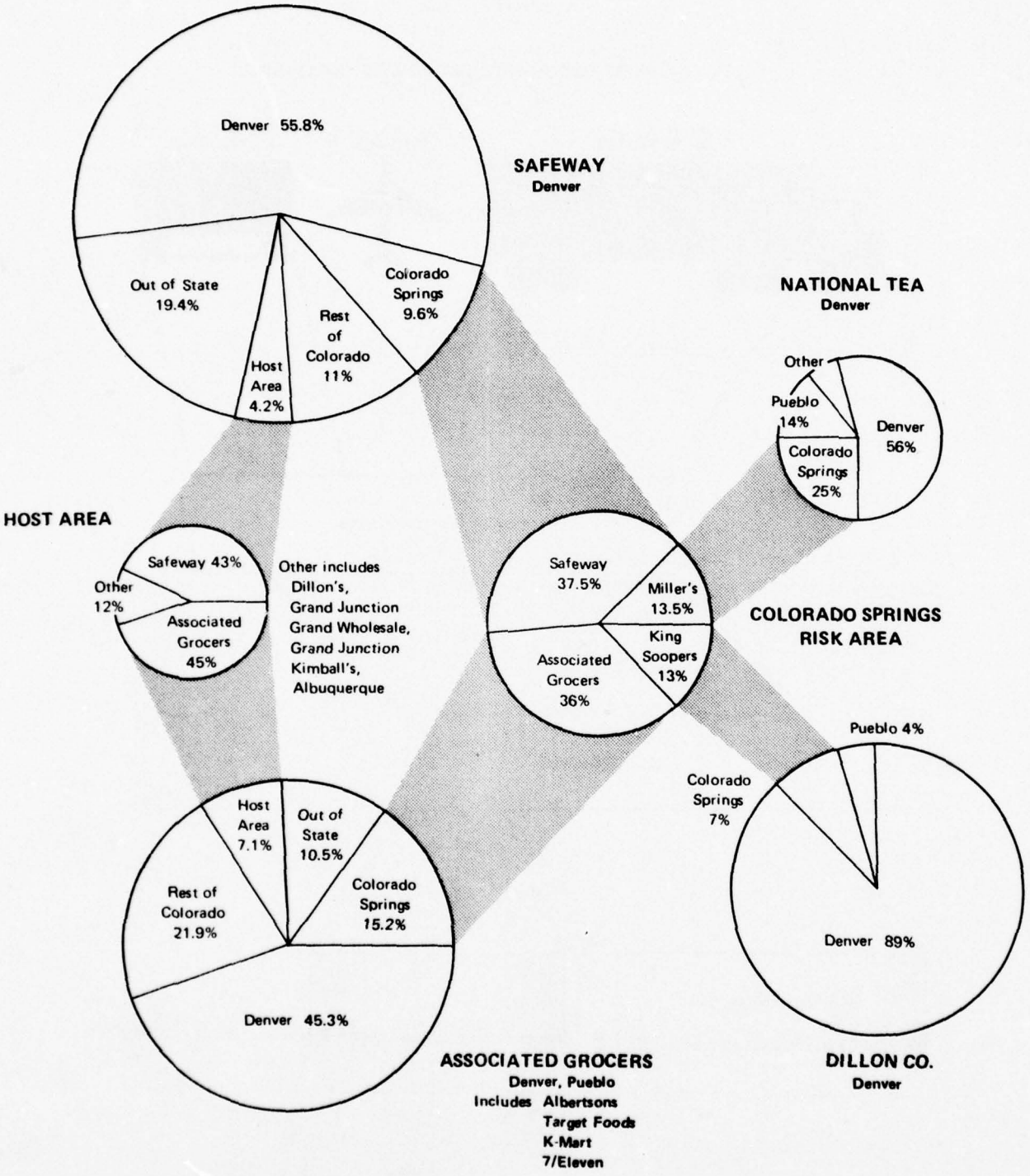
FLOW OF FOOD THROUGH DENVER, COLORADO



(Source: Reference 2)

EXHIBIT 3.3

SOURCES OF SUPPLY, COLORADO SPRINGS RISK AND HOST AREAS



(Source: Reference 2)

statistics show a high of 5.5 million hundred-weight in December, or enough to supply every resident of Colorado with emergency rations of potatoes for a period of two years.

3.2.3 Local Food Processing

Colokado Springs also relies heavily on Denver and points outside Colorado for most of the processing operations applied to food distributed locally. Only two food processors with plants located in Colorado Springs employ more than fifty people and can be said to command a significant share of the local or regional market. These two processors are the Sinton Dairy and the Coca-Cola Bottling Company. Of these two, only Sinton Dairy would continue its operations under conditions of crisis relocation.

3.3 OVERVIEW OF PROPOSED FOOD DISTRIBUTION ADJUSTMENTS

The distribution system adjustments proposed for the Colorado Springs area in support of a crisis relocation strategy parallel the adjustments outlined in Exhibit 2.2. Chief among these adjustments is the shift of supplies from risk-area retail outlets to host-area retail outlets. In general, Denver wholesale warehouses serving the study area population before evacuation will continue to do so after evacuation by shifting deliveries from their risk-area stores to their host-area stores. Food will be delivered to relocatees through a combination of retail outlets and mass feeding centers. Wholesale warehouses with host host-area outlets will supply mass feeding centers directly. The only major food processing activity within the risk area, the Sinton Dairy, will continue operations throughout the evacuation period.

3.3.1 Wholesaler Adjustments

Personnel from the Denver distribution centers of each of the major distributors supplying Colorado Springs were interviewed, and there was general agreement that the most efficient strategy for supplying food to evacuees under a crisis relocation movement would be to supply retail outlets in the host area with the food normally delivered to risk-area outlets, while continuing to operate the wholesale warehouses within the Denver risk area. None of the distributors felt that this would place an undue strain on the host-area retail outlets. Revised distribution patterns were worked out for each of the major distributors serving the study area.

Safeway faces the fewest problems in adapting its distribution patterns to support an evacuation of the Colorado Springs area. Safeway has seven stores in the Colorado Springs risk area and six stores in the Colorado Springs host area. The firm retains control of its goods from

the wholesale warehouse through the checkout counter, has a computerized ordering system, and anticipates few problems in shifting the bulk of its Colorado Springs orders to host-area outlets so long as its Denver distribution center is allowed to remain in operation.

In the case of the Dillon Company, regionwide adjustments were planned to balance the flow of food between the counties hosting Denver evacuees, where Dillon is well represented, and the counties hosting Colorado Springs evacuees, where Dillon has only a few outlets.

The National Tea Company, which controls 13.5 percent of the Colorado Springs risk-area market with five Miller's Supermarkets, has no outlets in the Colorado Springs host area. Moreover, each of its 31 Colorado retail outlets is located within a risk area. Under crisis relocation conditions, therefore, National Tea will have no readily-available corporate outlet for its wholesale food stocks. Accordingly, it is desirable that National Tea provide direct deliveries to the larger host-area mass feeding centers.

Associated Grocers has a larger number of stores in the host area (37) than any other firm. Unlike Safeway, National Tea and King Soopers, however, Associated Grocers loses control of its food once it is billed and shipped from the central warehouses, and cannot initiate orders from the central warehouse. Although its ordering system is computerized, it must depend on its independent retail outlets to initiate orders. Associated Grocers personnel saw no logistics problems in shipping all their food to host-area retail outlets in the event of an emergency, but the question of ownership and responsibility poses an extra organizational problem which must be considered.

3.3.2 Retailer Adjustments

Retail grocery stores within the risk area would be expected to observe any price controls and single-purchase limitations established during the pre-crisis period and the evacuation period. The remaining inventories would be reported to the Colorado Food Agency, and operations would cease for the duration of the crisis relocation period.

Chain stores with outlets in both risk and host areas -- such as Safeway and Dillon -- would arrange for employees to transfer to these outlets for the duration of the emergency. Employees of other chains and independent stores should be encouraged to seek employment in independent host-area retail outlets.

Retail outlets in the host area should remain open and expand their operations by using transferred risk-area personnel, extending business hours, authorizing overtime work, and stocking at night. Managers of host-area outlets should identify and use expedient storage space in parking lots, nearby warehouses, and garages to store incoming shipment overflows.

3.3.3 Potential Transportation Stress

So long as the major wholesale distribution centers located in the Denver risk area are maintained, the local adjustments required to direct large quantities of food to the host area need not interfere with the flow of national supplies into Colorado. These adjustments will, however, place a heavy strain on the local food transportation system. Supermarkets in the Colorado Springs area receive a minimum of one delivery of dry groceries each week from Denver wholesalers, with more frequent deliveries of meat and perishable items. The typical high-volume market receives an average of four deliveries of dry groceries per week, and daily deliveries of meat and perishables. Dry grocery deliveries are made by tractors and trailers owned and operated by the supermarket chain or independent wholesaler, as are most of the meat and perishable deliveries. The proposed distribution system adjustments will impose heavy stresses on the trucks and drivers currently employed by major Denver distribution centers. Instead of making relatively short delivery runs to Colorado Springs, trucks and drivers will have to continue far south of Colorado Springs to reach the host area. In order to determine the effect of a crisis relocation strategy on local delivery equipment, estimates were made of the additional mileage imposed on this equipment by such a strategy.

The transportation stress resulting from a crisis relocation was estimated by assuming that the four cities of Denver, Boulder, Pueblo and Colorado Springs would be evacuated simultaneously, and by computing the additional mileage imposed on the transportation fleets serving Denver distribution centers by this simultaneous evacuation. Transportation stress estimates were derived by dividing the current mileage consumed by each wholesaler in serving all its retail outlets (most of which are clustered near the warehouses in the risk area) into estimates of the mileage required to carry the same amount of food to those outlets located in host counties throughout Colorado. A stress factor of 3.04 was derived for all major Denver food wholesalers, indicating that the vehicle mileage required to make regular deliveries to host-county outlets would be more than triple the mileage currently consumed by local food deliveries.

Because existing drivers and equipment are not currently being employed at their maximum capacity, a tripling of vehicle mileage does not necessarily imply a tripling of transportation resources. A rough estimate of the additional equipment required by Denver-based food distribution centers is 162 tractors and 280 trailers. This represents approximately a 40-percent increase over the current fleet of 415 tractors and 650 trailers. In addition, nearly 465 drivers would have to be diverted from less critical sectors of the economy to join the drivers currently employed by food wholesalers, approximately doubling the current driver fleet size. Discussions with representatives of the Denver Chapter of the NDTA indicate the sufficient equipment and personnel can be made available from less critical Denver industries to meet these requirements (see Reference 2).

3.4 COMMODITY FLOW PATTERNS

The remainder of this section is devoted to a detailed consideration of the channels followed by eight commodity groups in reaching the Colorado Springs consumer. The eight commodity groups are:

1. Meat and meat alternates;
2. Milk and dairy products;
3. Eggs;
4. Cereals and cereal products;
5. Fruits and vegetables;
6. Food fats and oils;
7. Potatoes; and
8. Sugars.

The distribution of each commodity group is illustrated by a schematic flow diagram that traces food supply relationships, locates processing facilities, and shows the relative size of inventories held at each stage of the distribution system. This detailed characterization provides a basis for identifying possible postattack distribution bottlenecks and identifying alternatives for bypassing these bottlenecks.

3.4.1 Meat and Meat Alternates

A summary of Colorado meat production, imports, exports and consumption is shown in Table 3.1. Exhibit 3.4 shows Colorado meat distribution channels, volumes and inventory levels.

Colorado per-capita consumption of meat is estimated to be about 206.3 pounds per year. As a major meat producing and processing state, Colorado supplies most of its own meat requirements. Overall, about 60 percent of the meat consumed in Colorado is produced and processed within the State and about 40 percent is imported from outside the State.

3.4.1.1 Poultry.

In 1975, the national per-capita consumption of chicken was 30 pounds and of turkey was 8.6 pounds. In Colorado, chickens are grown primarily in support of egg production, and most (an estimated 80 million pounds annually or nearly 75% of total consumption) of the chicken meat requirement of Colorado is imported.

TABLE 3.1

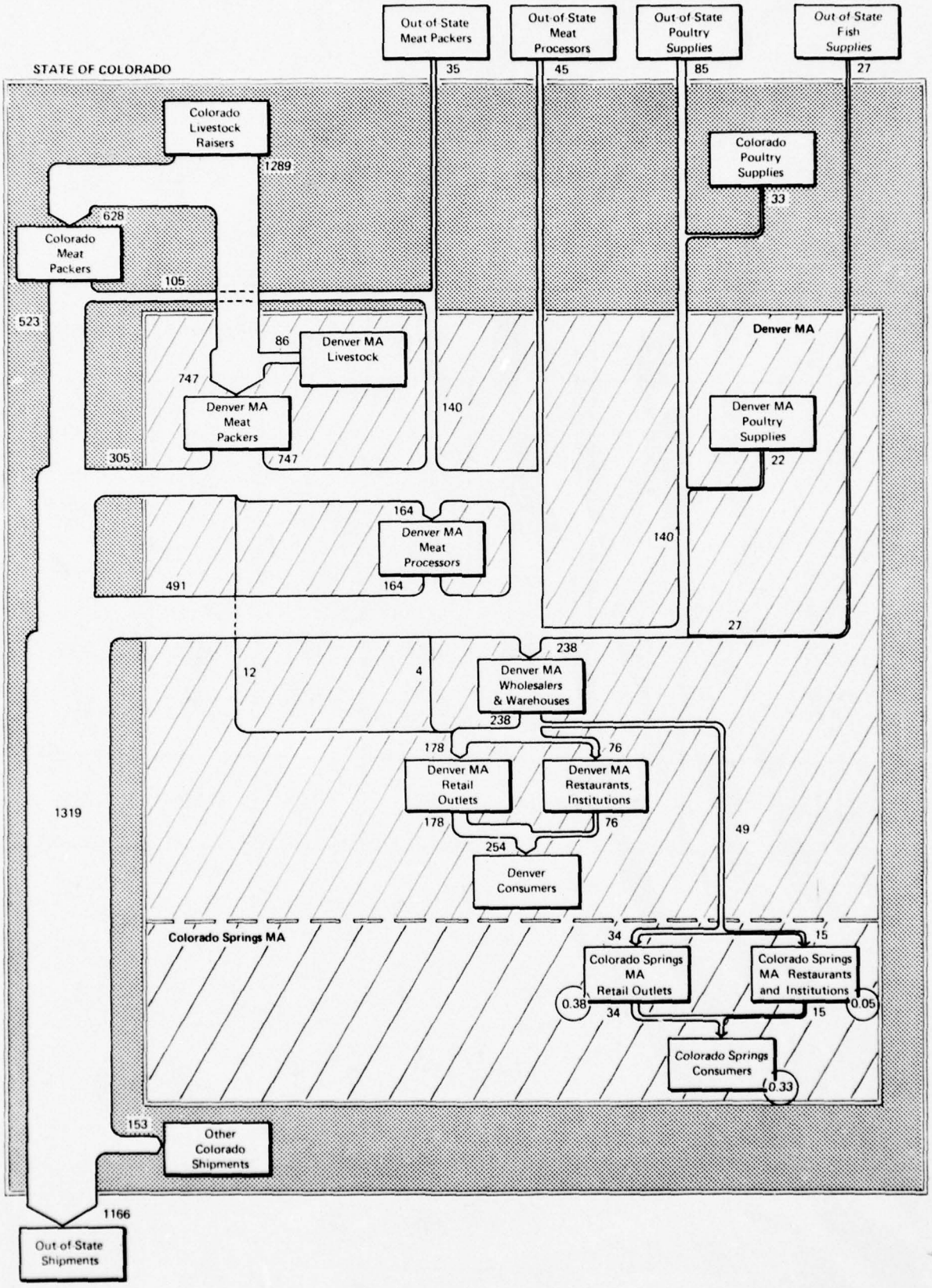
COLORADO MEAT AND MEAT ALTERNATES SUMMARY:

PRODUCTION, IMPORTS, EXPORTS, CONSUMPTION (MILLIONS OF POUNDS)

Product	Processing			Imports	Exports	Consumption
	Denver SMSA	Outside Denver SMSA	Total			
Chicken	2	2	4	85	--	89
Turkey	20	31	51	--	32	19
Poultry	22	33	55	85	32	108
Fish	--	--	--	27	--	27
Cattle, Hogs, Sheep						
Dressed	583	628	1211	35	1021	225
Processed	164	-	164	45	113	96
Total	747	628	1375	80	1134	321
Total Poultry, Fish, and Meat	769	661	1430	192	1166	456

EXHIBIT 3.4

DISTRIBUTION OF MEAT, POULTRY AND FISH IN DENVER AND COLORADO SPRINGS METROPOLITAN AREAS



Figures outside rectangles represent throughput in millions of pounds annually.

Colorado turkey production is substantial. It is estimated that Colorado produced approximately 50 million pounds of dressed turkey meat in 1975. Almost all processing is done by the turkey grower-processors. There are two major and several smaller such companies in Colorado. It is estimated that about 40 percent of the turkey meat output is consumed within the State and about 60 percent is exported. Most of the locally-raised poultry goes to the food chains and the balance to wholesalers for sale to other retailers, restaurants and institutions.

3.4.1.2 Fish.

For a number of years, the demand for seafood in the U.S. diet remained constant at 10.5 pounds per person; since aabout 1970, however, per-capita consumption has been increasing and in 1974 and 1975 was 12.1 pounds per person. More than half of U.S. seafood consumption is imported, with Japan being the chief supplier. Using the U.S. per-capita average, the 1975 estimated Colorado fish consumption is estimated at 26.8 million pounds.

3.4.1.3 Red Meats/Livestock Raising.

Colorado is a major livestock-raising state. In 1975, Colorado farmers marketed 2,583,000 cattle and calves, 431,000 hogs, and 1,300,000 sheep and lambs. Although cattle are raised in almost all counties of Colorado, cattle raising is more concentrated in the eastern and northeastern part of the State. In 1975, about half the cattle were raised in the eleven counties of Baca, Kit Carson, Larimer, Logan, Lincoln, Mesa, Morgan, Prowers, Washington, and Weld. Sheep and hogs are also raised in most counties, but sheep raising is more concentrated in the northwest and southwest. Most hogs are raised in the eastern portion of the State.

3.4.1.4 Meat Processing.

Most of the major meat packing and slaughtering plants are located in Denver, but several are located in outlying cities such as Sterling, Greely and Fort Morgan. The largest slaughtering, packing and processing facility -- Montfort Packing Company -- is located in Greely, Weld County, north of Denver. The major hog-packing and processing firm -- Sigman Meat Company -- is located in Brush, Morgan County.

The Montfort Packing Company exports most of its production. Most of the meat exported from Colorado is in dressed form; only about 10 percent is in processed product form.

The bulk of red meat entering Denver is distributed through the chains and independent wholesale warehouses or institutional purveyors.

Chains such as Safeway, King Soopers and Associated Grocers (representing smaller chains and independents) buy carcasses directly from packers and cut to their own requirements, then distribute to their stores. Institutional suppliers such as Lombardy and Weimer carry out the same functions in their respective facilities. Almost all of the work is done in Denver.

Colorado imports about 40% of the meat consumed by its residents. Two of the main out-of-state supply points are Garden City, Kansas and Hereford, Texas.

3.4.2 Milk and Dairy Products

In 1975, fluid milk and cream per-capita consumption (product weight basis) in the United States was 250 pounds, according to the USDA Economic Research Service. Direct fluid milk and cream per-capita consumption in Colorado is approximately 251 pounds on a milk-equivalent basis. Colorado's apparent per- capita total fluid milk and dairy product consumption was about 356 pounds in 1975 (786 million pounds/ year, 2,207,300 population). The 356-pound figure includes about 105 pounds (29%) of such manufactured milk products as cheese and ice cream.

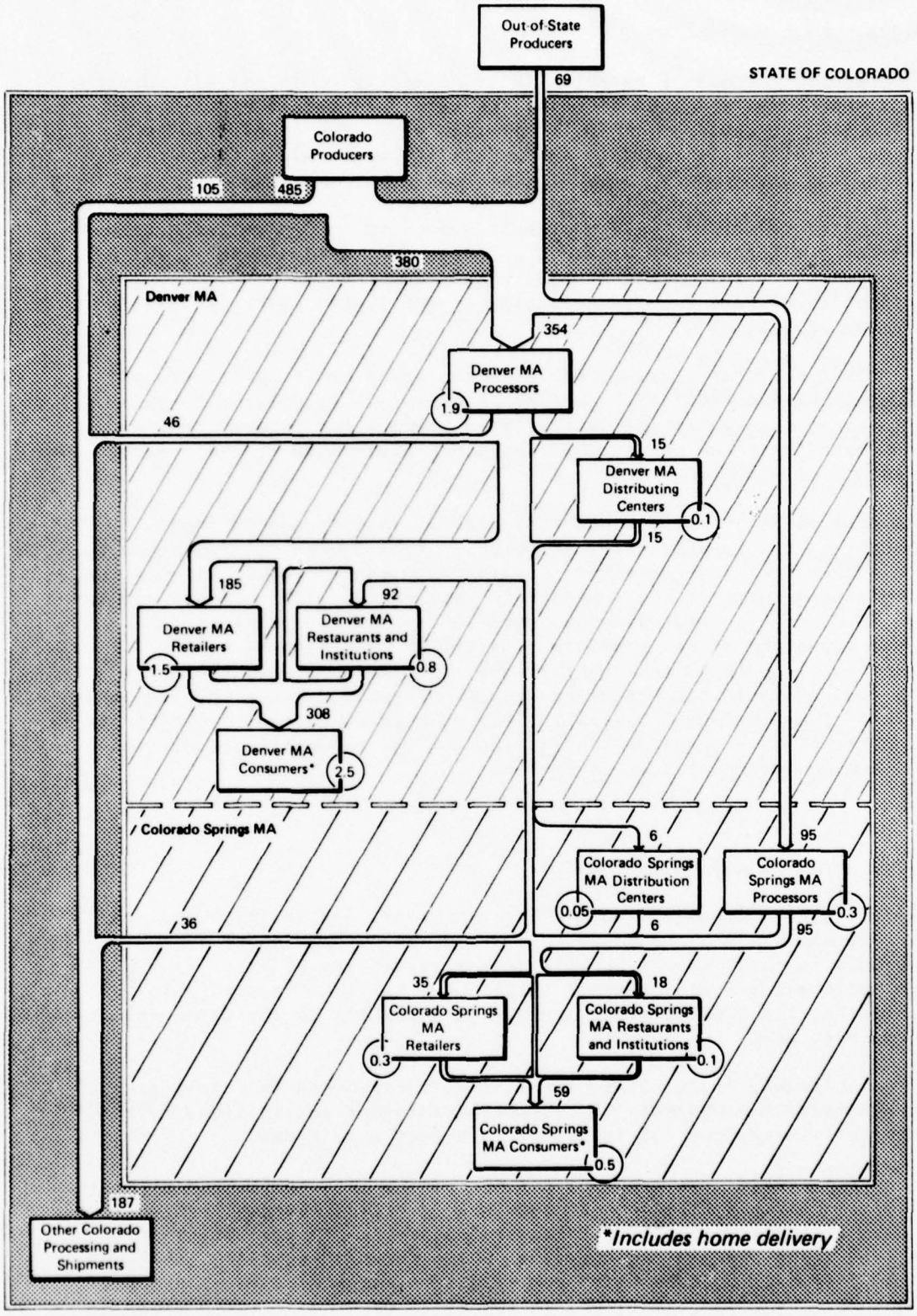
In Colorado, and particularly within the Denver and Colorado Springs risk areas, the dairy farms, processing plants, and retail food stores have undergone major changes since World War II. Economies of scale have forced many small operators out of business, leaving market control in the hands of large companies. Large retailers are beginning to process large quantities of fluid milk. However, the dairies continue to operate independently of the processor. The bulk of fluid milk sales to the Colorado consumer now occurs in retail grocery stores, and almost all manufactured milk products reach the consumer through usual grocery wholesale/retail distribution channels. Milk sources, processing aspects, and distribution channels are summarized in Exhibit 3.5.

3.4.2.1 Milk Production.

In 1975, Colorado milk production was 672 million pounds. This volume of production does not meet Colorado's demand, and the State imports from 10 to 15 percent of its total consumption from outside its boundaries. Unprocessed fluid milk imports amounted to about 96 million pounds in 1975. Weld County, north of Denver, is first in milk production in the State, accounting for more than one-third of total production. The three counties northeast of Denver -- Weld, Adams and Morgan -- produce more than half of Colorado's fluid milk.

EXHIBIT 3.5

DISTRIBUTION OF FLUID MILK IN THE DENVER AND COLORADO SPRINGS METROPOLITAN AREAS



Figures outside rectangles represent throughput in millions of pounds annually.
Figures inside circles represent inventory in millions of pounds.
Data includes fluid milk for drinking only and excludes products.

3.4.2.2 Milk Processing.

Milk processing consists essentially of pasteurizing the milk to destroy harmful bacteria, and then blending the milk into market requirements for low-fat, homogenized, skim, chocolate, etc. The final step is putting the milk into suitable containers for private and commercial consumers.

Most of Colorado's milk supply is processed in Denver and nearby counties. Milk processed within the Denver SMSA accounts for about 64 percent of the total milk consumed in Colorado. Another 17 percent is processed in El Paso County, primarily at the Sinton Dairy facilities in Colorado Springs.

Milk's perishable nature dictates wholesale handling techniques that minimize the handling time from processor to retailer. In some instances -- such as in the case of King Soopers and Safeway --major chains have their own processing plants and distribute to their own stores.

Sinton Dairy operates a processing plant in Colorado Springs. Although not the largest dairy in Colorado (the Denver dairies operated by Safeway and King Soopers have considerably more volume), it commands a significant share of the Colorado Springs market. The company has two large 50,000-gallon site storage tanks for raw milk, and maintains a one-day inventory of raw products. Typically, one silo is used while another is being refilled. Most of the raw milk supplying the dairy comes from farms to the south and east of Colorado Springs, particularly the Canon City and Pueblo areas. These sources would continue to produce under crisis relocation conditions, and their location is particularly convenient under such conditions.

3.4.2.3 Milk Distribution.

Local deliveries to retail outlets, restaurants, and institutions are generally made by the processor. As noted above, some major chains distribute to their stores from their own processing plants. Sinton Dairy, with its processing plant in Colorado Springs, is particularly important in the home delivery and military markets in the Colorado Springs risk area.

In Colorado, about 60% of the milk is distributed to retail stores (predominantly the chains), 30% to restaurants and institutions (including the military), and 10% is delivered directly to homes.

Current fluid milk handling and processing techniques have significantly extended the lifetime of fresh milk. Milk is commonly three to six days old by the time it reaches the consumer. It will maintain excellent taste properties in excess of two weeks if exacting sanitary and temperature standards have been applied at each producing, processing and holding stage. The largest volume of milk is normally found at retail and consumer levels.

3.4.3 Eggs

The national per-capita consumption of eggs has been decreasing slowly since 1960. U.S. per-capita consumption was about 35.3 pounds in 1975, which is similar to the estimates for Colorado per-capita consumption made by the Colorado State Department of Agriculture. Total Colorado egg consumption for 1975 was 77.91 million pounds.

Egg production and sales in Colorado have increased substantially during the past few years, from 27.38 million pounds sold in 1968 to 47.38[2] million in 1974. In 1975, the flock size was 1.7 million; each hen laid an average of 235 eggs during the year.

Eggs are produced in a number of counties in Colorado, but the main concentration of production is in the Denver area. It is estimated that about 75% of all egg production is within 25 miles of Denver, the major market and distribution point. In 1974, Colorado produced about 60% of the eggs consumed within the State.

3.4.3.1 Processing.

All the eggs brought into Colorado from other states are graded at point of origin. Of those eggs produced within Colorado (mostly on large farms), about 60% are washed, weighed, graded and cartoned by the producer. The remaining 40% of the production is prepared by off-farm wholesalers. Virtually all processed eggs -- dehydrated, frozen, etc. -- are imported. Bakeries are the primary users of these eggs. There are no major egg breakers in Colorado.

3.4.3.2 Egg Marketing Channels.

Probably 95% of the shell eggs reaching consumers in the Denver and Colorado Springs area move through retail stores, restaurants and institutions. The remainder are delivered by peddlers or sold by producers at farmers' markets or on egg routes.

About 75% to 80% of the eggs imported or produced in Colorado come into the Denver SMSA; about 30% of that quantity then goes out of the Denver SMSA for distribution to other parts of the State. It is estimated that about 5% of Colorado's egg production is exported. Egg sources and marketing channels for the Denver MA and Colorado Springs MA are illustrated in Exhibit 3.6.

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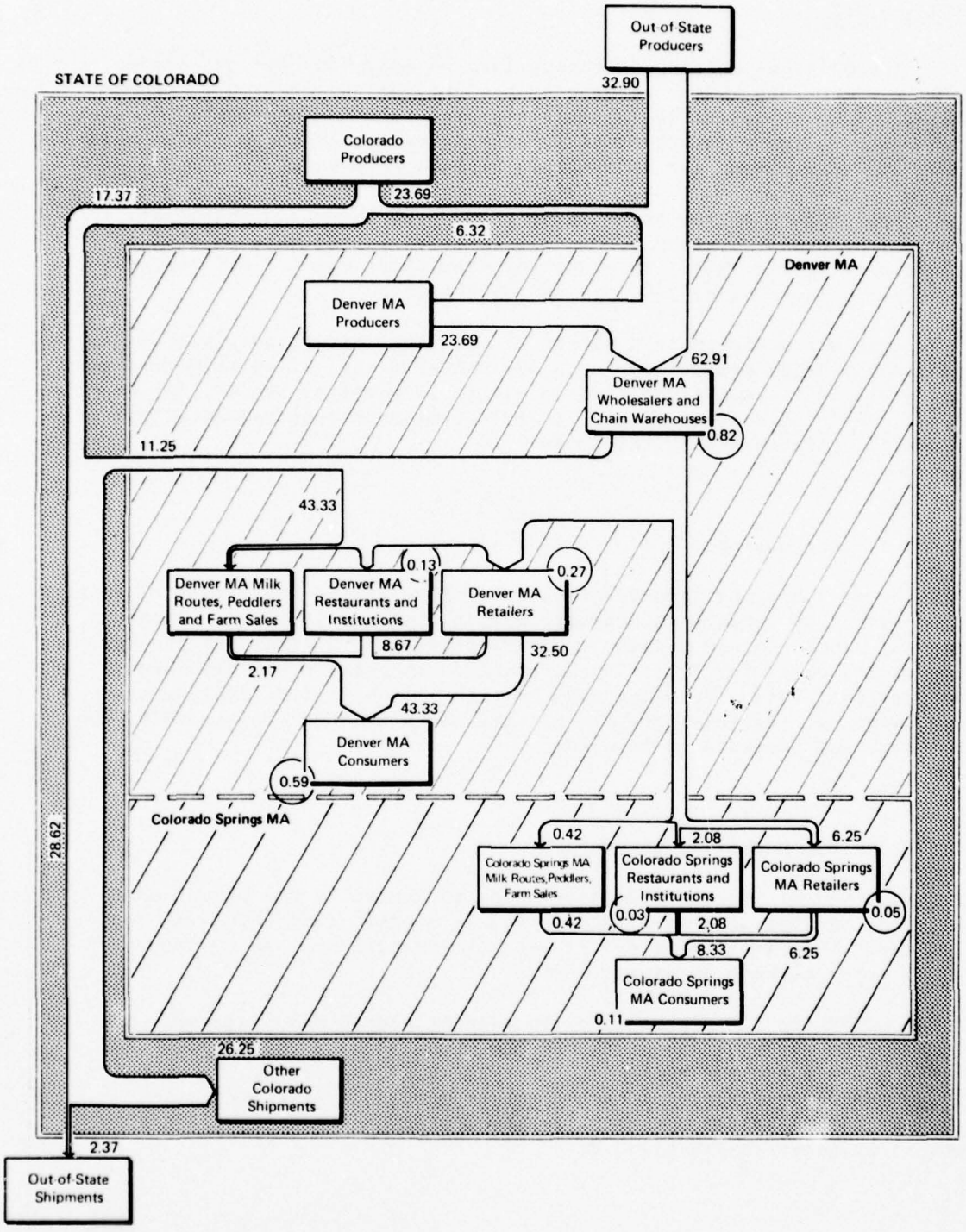
[2]Number of eggs sold: 379 million at two ounces per egg = 47.38 million pounds.

EXHIBIT 3.6

DISTRIBUTION OF SHELL EGGS IN THE DENVER AND COLORADO SPRINGS METROPOLITAN AREAS



Figures outside rectangles represent throughput in millions of pounds annually.
Figures inside circles represent inventory in millions of pounds.

3.4.4 Cereal and Cereal Products

The distribution patterns of cereals and cereal products in the Denver and Colorado Springs metropolitan areas are shown in Exhibit 3.7.

3.4.4.1 Wheat Production and Distribution.

Unlike most cereal grains, wheat is processed principally for human consumption and, as such, provides nearly 20% of the food energy of the national diet. Most of the wheat destined for human consumption is milled to produce flour for use in making bread and other bakery products. A much smaller proportion of the annual harvest is converted into breakfast foods and such edible pastes as macaroni and spaghetti.

Wheat is moved from the producer to the flour-miller through a number of marketing agents and storage facilities. Harvested wheat may be hauled directly to a country elevator, or it may be stored on the farm before marketing. In any case, the commercial marketing of the yearly wheat crop usually begins at local country elevators. The local storage facilities generally have a capacity ranging from 20,000 to 30,000 bushels of grain.

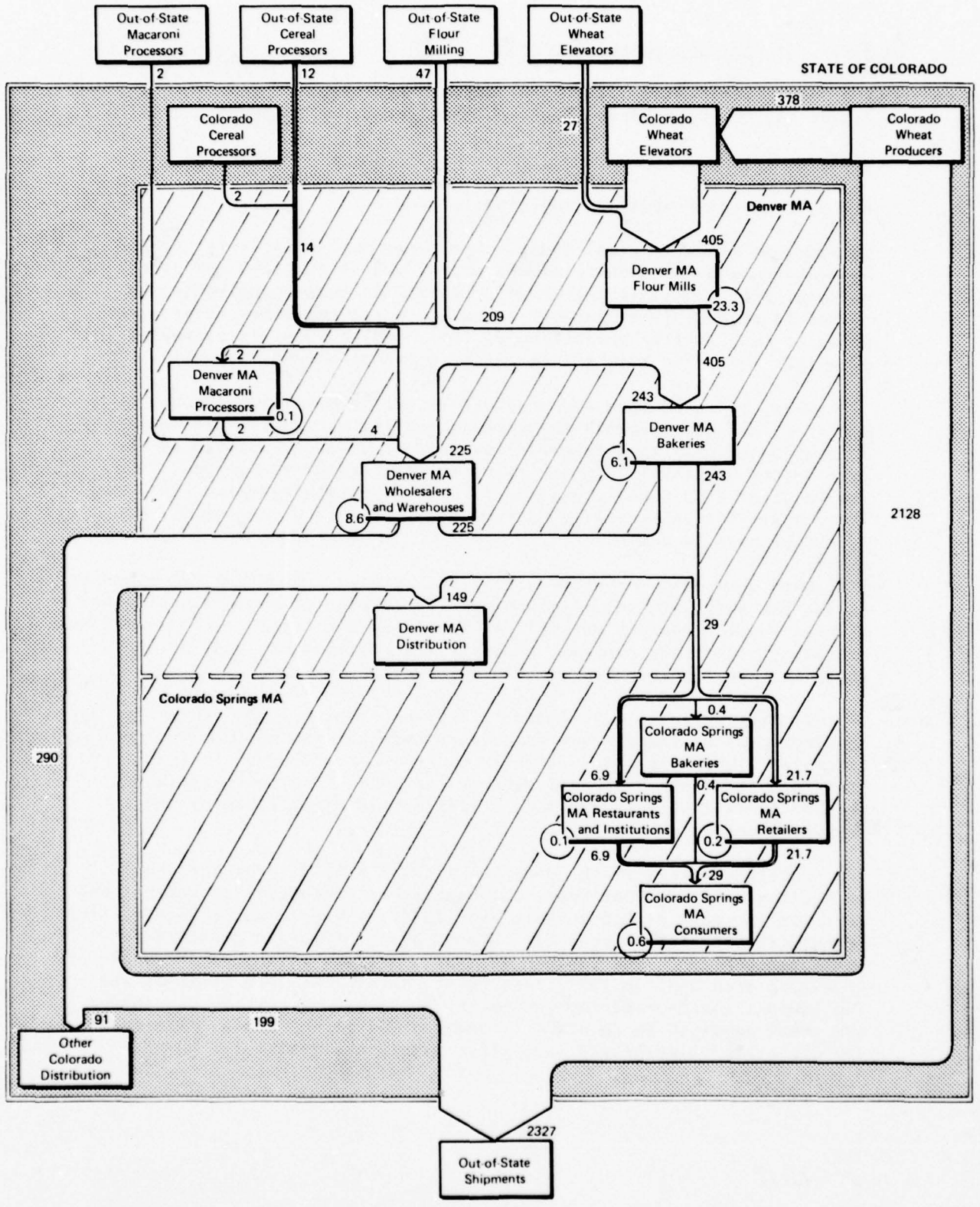
When the country elevators have accumulated a substantial volume of grain, the wheat is most often shipped to terminal elevators. Alternatively, local elevators may deliver their grain directly to flour mills or make it ready for export. Whatever its destination, most of the wheat shipped from country elevators travels by rail.

Terminal elevators, located in the important milling centers of the country, provide the storage reserviors necessary in the grain-marketing channels. These elevators range in capacity from 300,000 to 10 million bushels. Besides substantial storage capacity, terminal elevators provide facilities for weighing, inspecting, drying, cleaning and marketing grain.

Colorado ranked sixth among the states in 1973 in winter wheat production. During that year, Colorado farms produced 24.5 bushels per acre (an increase of 0.5 bushels over 1972), for a total of 58.8 million bushels (3,528 million pounds). Almost all of this was destined for human consumption. The eastern part of the State is the major wheat-producing area and, in 1973, Baca County in southeastern Colorado was the largest wheat-producing county in the State. About five-sixths of the wheat produced in Colorado is shipped out of the State. The remaining one-sixth is processed into flour within the State.

EXHIBIT 3.7

DISTRIBUTION OF CEREALS AND CEREAL PRODUCTS IN DENVER AND COLORADO SPRINGS METROPOLITAN AREA



Figures outside rectangles represent throughput in millions of pounds annually (milled flour equivalent)

Figures inside circles represent inventory in millions of pounds.

3.4.4.2 Flour Milling.

Most of the wheat stored in country and terminal elevators eventually moves by rail to a flour mill. On arriving at the mill, wheat is weighed, cleaned, dried, and then stored in large concrete bins. Most mills store at least six weeks' supply of raw wheat. As grain is needed for milling, wheat is drawn from this supply and put through another cleaning process. The wheat is then conditioned and milled into flour and its byproducts. Wheat food value decreases after milling, and millers usually ship flour within several days of its production.

Colorado's total production of winter wheat in 1973 was 3,528 million pounds. U.S. per-capita wheat flour consumption would be 147 pounds, as flour is about 74% the weight of the original wheat. Other grains add about 7 pounds per capita to the wheat flour consumption, bringing the total to 116 pounds per capita in the United States. Colorado per-capita grain consumption (milled flour equivalent basis) is estimated to be about 122 pounds per capita. The averages in the United States and Colorado vary from year to year. Colorado grain consumption is estimated at approximately 269 million pounds per year.

In Colorado, about 540 to 550 million pounds of wheat is milled annually, or about 15 percent of the total State wheat production. The major flour-milling company is located in Denver. About 40% of the flour production is shipped out of the State.

In Colorado, flour is used primarily for bread, manufactured goods (cookies, crackers, cake mixes) and pastries. Approximately 60% of the flour milled in Denver is sent in bulk to bakeries for bread, cookies, crackers, etc. Approximately 10% is sent in bags to restaurants and institutions and 30% to retailers. Most of the latter 30% is sent to chain stores.

3.4.4.3 Bread Production and Distribution.

The chief ingredients of bread are wheat flour, shortening, water, yeast, sugar and salt. These ingredients are combined with various flavoring and enriching additives in large, electrically-operated mixers. The dough is then fermented and mechanically kneaded, shaped and panned for baking. When ready for baking, the dough is conveyed to an automatic oven where heat is applied steadily for 20 to 30 minutes. The bread is then cooled, sliced and wrapped for delivery. In modern bakeries, the entire operation may be completed in eight hours or less.

Bread will begin to lose its marketing value on the second day after baking, even though it remains edible for some time thereafter. Thus, the bakers consider it essential that bread be delivered to a retail outlet shortly after baking. Bread production in the Denver metropolitan area takes advantage of rapid truck deliveries and the economic advantages of scale to concentrate most of the area's bread-baking capacity in Denver. Rainbo Bakery, located in Pueblo, represents

about 4% of Colorado's baking capacity. Most the bakeries obtain the majority of their flour from mills within the State of Colorado. The major bakeries buy flour in bulk; most restaurants and institutions and smaller bakeries buy flour in bags through wholesalers. Retail chains buy directly from the flour mills. Most of the shortening for baking purposes is purchased from local meat processors.

3.4.4.4 Miscellaneous Cereal Products.

In addition to bread and related products, manufacturing bakeries in the United States annually produce more than 8 billion pounds of biscuits, crackers, ice cream cones and pretzels. The four basic stages in the manufacture of these items -- mixing, oven feeding, baking and packaging -- have been largely automated in recent years. These items enter the distribution system at the wholesale and retail levels. Because these items are generally less perishable than bread, they tend to follow ordinary grocery marketing channels in reaching the consumer.

Little regional competition exists in the breakfast food industry. The six largest manufacturers of breakfast in the United States hold most of the market, and distribute their products nationally. These products enter the distribution system at the grocery wholesale level. Similar marketing patterns are followed by other manufactured cereal products.

Colorado manufactures and ships out of the State a considerable quantity of biscuits, crackers, cookies and similar products (approximately 37 million pounds annually).

3.4.5 Fruits and Vegetables

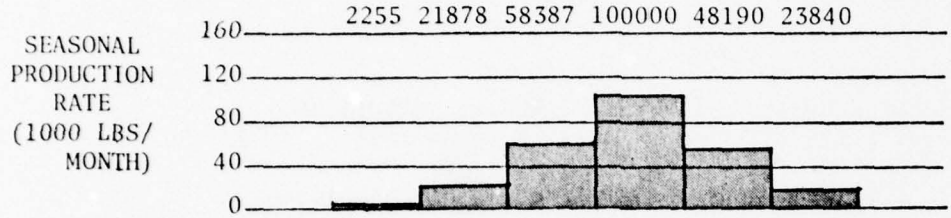
3.4.5.1 Production.

In 1975, Colorado produced over 250 million pounds of fruits and vegetables (excluding potatoes). Total value was approximately $44.5 million. It is estimated that roughly half of the State's production is exported. Perishable crops are harvest over a period of several weeks or months, and the State's harvest exceeds the amount that can be consumed within the State. About 75 percent of Colorado's fresh fruit and vegetable consumption volume is imported, and about 25 percent grown within the State.

Colorado is a major producer of apples, potatoes (considered separately) and onions; these crops are stored in the growing areas and shipped to Denver and points outside the State over a period of several months. The growing easons and production volumes of Colorado's fruit and vegetable crops are shown in Exhibit 3.8.

EXHIBIT 3.8

COLORADO FRUIT AND VEGETABLE PRODUCTION, 1975



	MONTHLY PRODUCTION (1,000 LBS)	TOTAL PRODUCTION (1,000 LBS)
APPLES	44,000	110,000
PEACHES	11.133	16,700
PEARS	8,800	13,200
CHERRIES	2,255	4,510
SPINACH	1,800	3,600
TOMATOES	12,710	25,420
SWEET CORN	2,100	3,150
CUCUMBERS	13,017	39,050
CABBAGE	1,840	7,360
CANTALOUPE	775	1,550
ONIONS	6,572	16,430
CARROTS	1,300	3,900
LETTUCE	4,800	9,680
TOTAL		254,550

MAY JUN JUL AUG SEPT OCT NOV DEC

COMMODITY PRODUCTION

A relatively small percentage of Colorado's fruit and vegetable crop is processed; the balance is consumed within the State or exported. Denver has one medium-sized and several small fruit and vegetable canning operations. Colorado Springs has no fruit and vegetable canning plants. A summary of production, imports, exports, and consumption data is shown in Table 3.2:

TABLE 3.2

A SUMMARY OF COLORADO FRUIT AND VEGETABLE PRODUCTION, IMPORTS, EXPORTS AND CONSUMPTION DATA, 1975

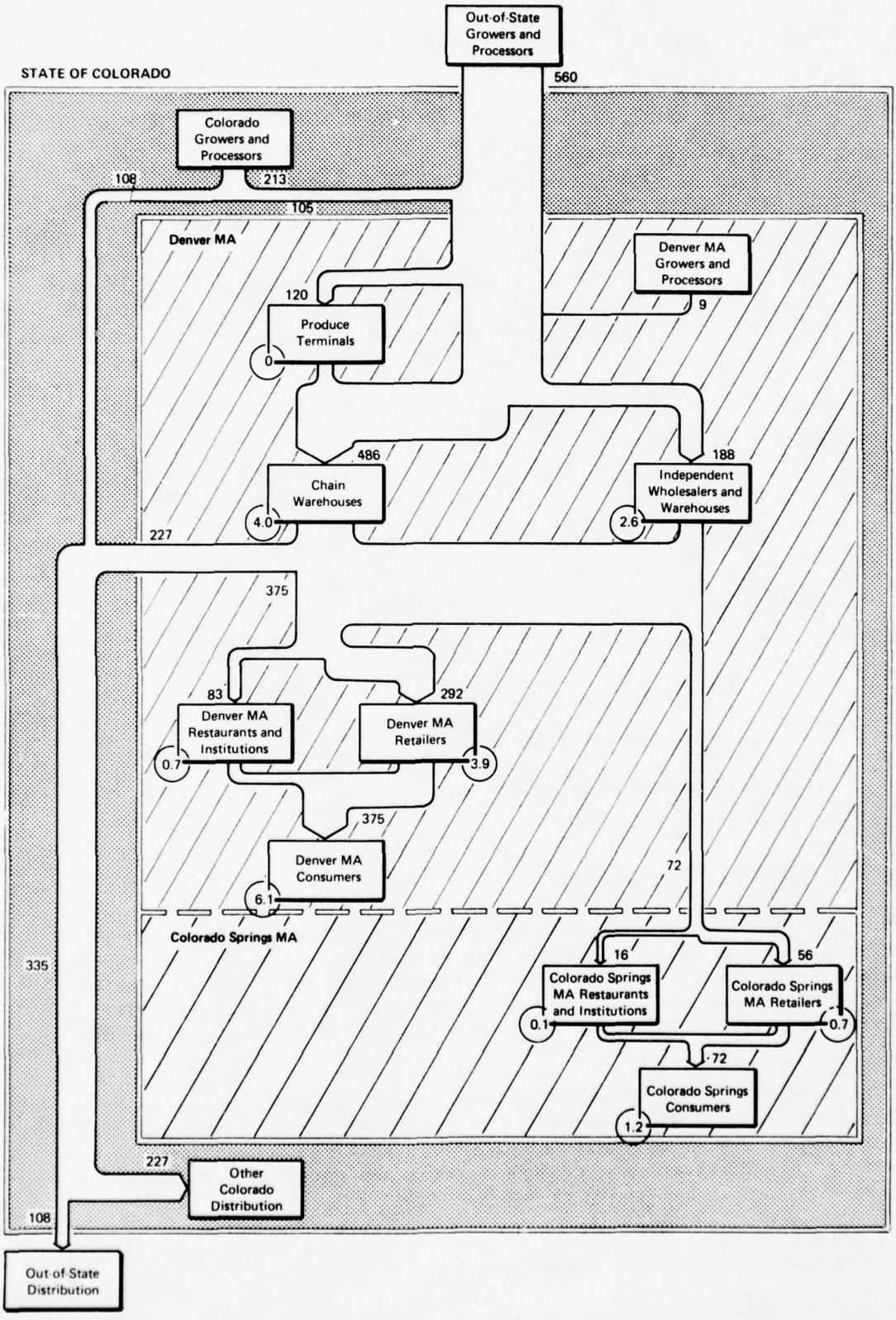
Type	Production	Imports	Exports	Consumption
Fresh	208	301	108	401
Processed	14	259	0	273
Total	222	560	108	674

3.4.5.2 Distribution.

Fresh produce marketing is dominated by the perishable nature of the products and the fluid nature of the markets. Large quantities of many varieties of fruits and vegetables must be moved quickly from the grower to the consumer. Almost all fresh (local and imported) produce reaches the retail level in Colorado through the retail chains (including Associated Grocers) or through the Denargo Produce Market to independents. A small amount goes directly to independent wholesale warehouses. The major food store chains constitute the largest wholesale distributors of fruits and vegetables, accounting for about 70 percent of the fruit and vegetable volume. The large volumes of locally-grown or imported produce are purchased and received at central warehouses directly from larger-scale producers that are under quasi-contractual agreements to make their production available on an almost routine basis to one of the food chains. The Denargo Market in Denver is another significant channel for fresh fruits and vegetables, serving primarily institutional and other retail wholesalers.

As indicated above, only a relatively small percentage of Colorado's fruit and vegetable crop is processed. It is estimated that about 95 percent of all processed fruits and vegetables consumed in Colorado are imported from outside the State; only 5 percent is produced and processed within the State. As with fresh produce, the bulk of processed fruits and vegetables are sold through retail chains. Overall retail outlets handle an estimated 75 percent of processed fruits and vegetables, and restaurants and institutions 25 percent. The distribution channels and volumes of fresh and processed fruits and vegetables are shown in Exhibit 3.9.

EXHIBIT 3.9
DISTRIBUTION OF FRUIT AND VEGETABLES IN THE DENVER AND COLORADO SPRINGS METROPOLITAN AREAS



Figures outside rectangles represent throughput in millions of pounds annually.
Figures inside circles represent inventory in millions of pounds.

3.4.6 Food Fats and Oils

In 1974, U.S. production of food fats and oils was 19,393 million pounds. Production has been increasing gradually over the past few years. In spite of production increases, however, the nation's per-capita consumption of edible fats and oils has remained relatively constant over the past four decades. The present breakdown of U.S. per-capita consumption is shown in Table 3.3 below:

TABLE 3.3

PER-CAPITA CONSUMPTION OF FOOD FATS AND OILS, 1974

Food Fats and Oils	Pounds Per Capita
Table Spreads:	
Margarine	11.3
Butter	4.6
Subtotal	15.9
Cooking Fats:	
Lard	3.2
Shortening	17.0
Subtotal	20.2
Other Edible Fats and Oils	20.3
Total Product Weight	56.4

3.4.6.1 Vegetable Fats and Oils.

Forty years ago, animal products such as butter and lard made up 65% of the edible fats and oils consumed in the United States; today, vegetable oils lead with over 70% of the total. The two most important vegetable oils produced in the United States are soybean oil and cottonseed oil, with soybean oil accounting for more than two-thirds of the total production.

The Midwest is the center of soybean production and processing in the United States. Cottonseed oil is a by-product of the southern cotton industry. Bulk shipments of vegetable oil from processing centers in the midwestern and southern states are usually in rail tank-cars.

Colorado is not a significant soybean or cotton producer, and no soybean or cotton processing plants are located in the State.

3.4.6.2 Butter.

Colorado produces only about 7% to 8% of its butter requirements of about 10 million pounds per year; thus, out-of-state sources account for over 90% of total Colorado butter requirements. The major butter producers are all located in Denver; Beatrice Foods and Meadow Gold are the two largest producers. No significant quantities of butter are produced in Colorado Springs.

3.4.6.3 Other Animal Fats and Oils.

Colorado is a major meat (beef, pork, lamb) producing and processing state. A number of the larger meat-packing companies have tallow-rendering operations. Tallow production figures were obtained from the USDA office in Denver, and regional production and distribution was determined according to the size and location of the major meat processing plants. Edible tallow and lard production estimates are as follows:

Area	Millions of Pounds		
	Beef Tallow	Lard	Total
Denver SMSA	29		29
Colorado Springs SMSA	--		
Other Colorado	26	4	30
Total Production	55	4	59

Animal fat goes almost exclusively for industrial uses, i.e., primarily to bakeries. After rendering, raw tallow is further processed into shortening before it is used by bakeries. In Colorado, this is done primarily by Rust Sales of Denver, which produces about 35 million pounds per year. More than half of the company's shortening production is exported. Animal-based tallow and lard products are used primarily by industrial food processors, bakeries, donut shops and institutional users such as fast-food chains. The resulting products are sold in institutions and retail stores. Some are also sold directly through retail stores.

Data on total Colorado production, imports, exports, distribution and consumption of food fats and oils are summarized in Table 3.4 and illustrated in Exhibit 3.10.

3.4.7 Potatoes

In 1975, Colorado produced over one billion pounds of potatoes, placing it in tenth place among the potato-growing states. The major growing area in Colorado is the San Luis Valley, located in the southern

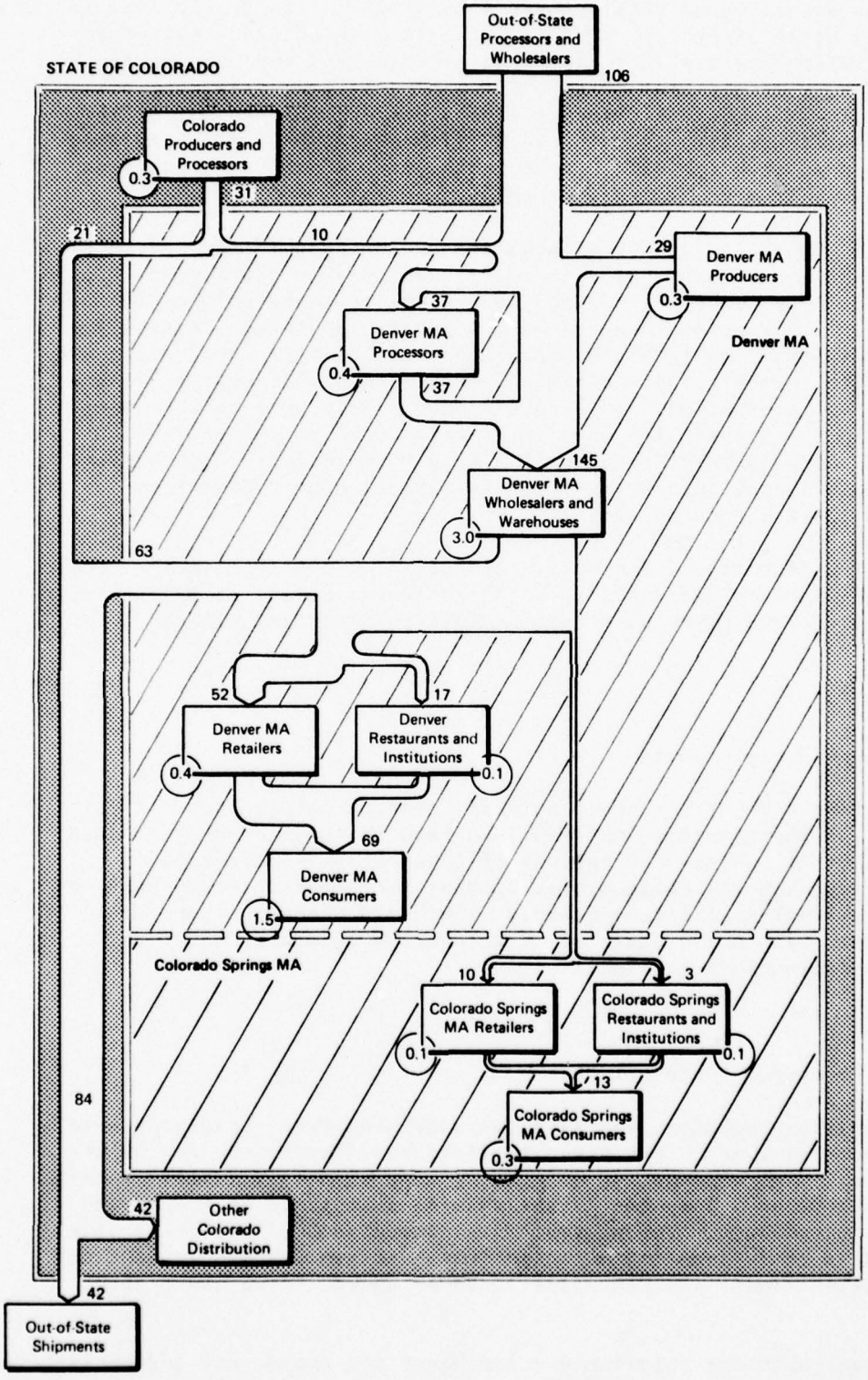
TABLE 3.4

SUMMARY OF COLORADO FOOD FATS AND OILS PRODUCTION, IMPORTS, EXPORTS AND CONSUMPTION (MILLIONS OF POUNDS)

Item	Production	Imports	Exports	Consumption
Vegetable Fats & Oils		87		87
Butter	1	9		10
Other Animal Fats & Oils	59	10	42	27
Totals	60	106	42	124

EXHIBIT 3.10

DISTRIBUTION OF FOOD FATS AND OILS IN THE DENVER AND COLORADO SPRINGS METROPOLITAN AREAS



Figures outside rectangles represent throughput in millions of pounds annually.
Figures inside circles represent inventory in millions of pounds.

part of the State. Some potatoes are also grown in the Greely area in Weld County north of Denver. Potato harvesting in Colorado begins in August; potatoes are stored in the growing areas and are shipped to Denver and outside the State from mid-August until the beginning of June. About 70% to 75% of Colorado's potatoes are shipped out of the State. A small quantity (about five million pounds) of fresh potatoes is also shipped into the State during the summer months when potatoes are not moving from the storage warehouses.

About 100 million pounds of potatoes are shipped to the Denver area from the San Luis Valley during the 9-1/2 months from mid-August through May. In addition, most of the Weld County potatoes are shipped to Denver. All major potato processors are located in Denver, except two starch companies at Monte Vista in the San Luis Valley. Production and shipment data indicate that Colorado consumes about one-quarter to one-third of total production. This corresponds fairly well to U.S. per-capita consumption estimates applied to Colorado. On the basis of information supplied by the National Potato Promotion Board in Denver, Colorado potato consumption for 1975 was estimated at 276 million pounds, or 125.2 pounds per capita.

The flow of potatoes and potato products to consumers in the Denver and Colorado Springs metropolitan areas is shown in Exhibit 3.11. Table 3.5 summarizes 1975 Colorado potato production, imports, exports and consumption.

3.4.7.1 Fresh Distribution.

Fresh potatoes account for about half of Colorado potato consumption. Almost all of the potatoes destined for fresh consumption are produced within the State. Almost 70 percent of these fresh potatoes go to retail stores, and the chain stores account for about 70 to 75 percent of all retail sales of fresh potatoes. About 20 percent of the fresh potatoes used within the State go to Colorado processors, and the balance to restaurants and institutions.

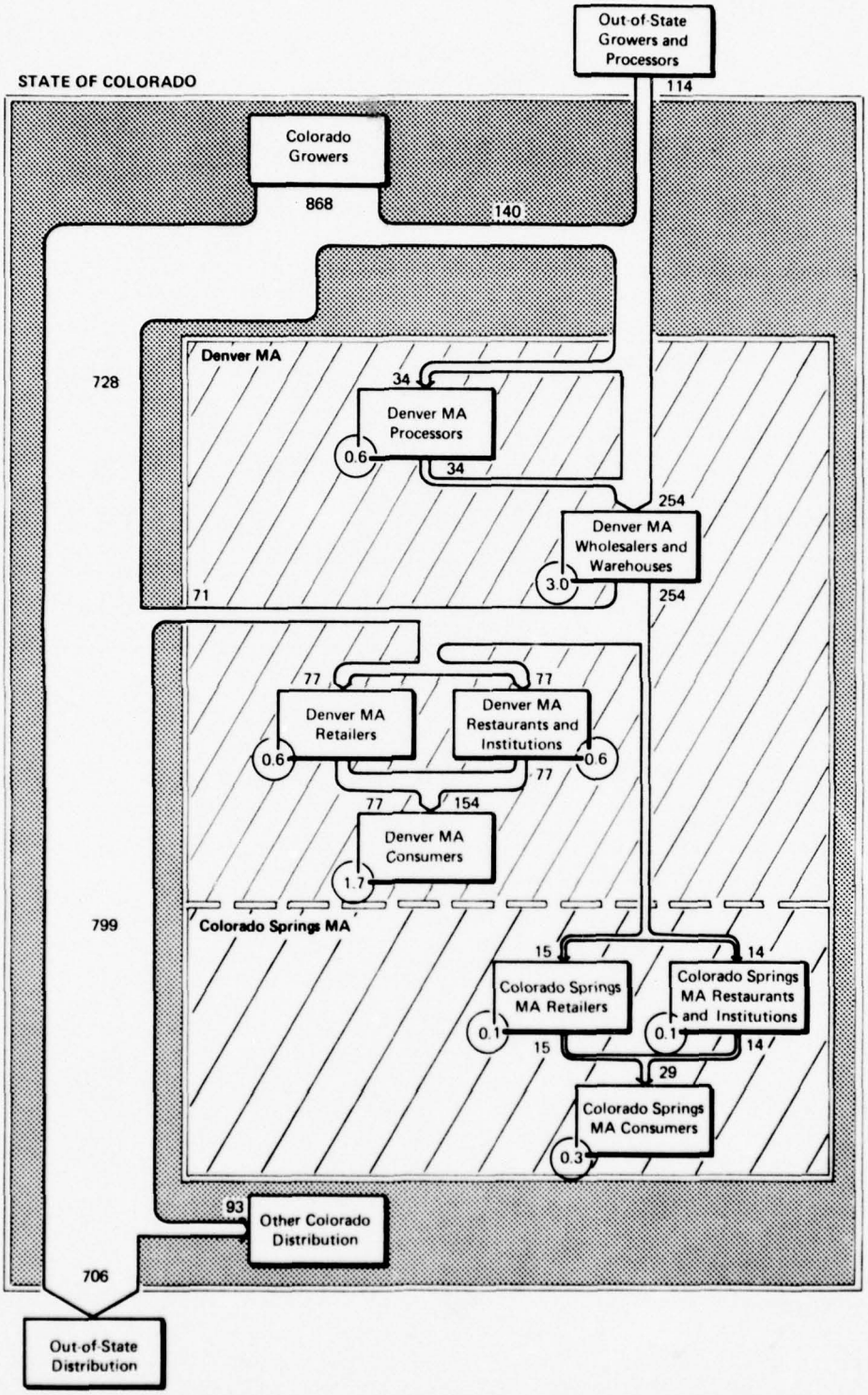
3.4.7.2 Processed Distribution.

The U.S. potato-processing industry has undergone very rapid growth in the last several years. Processed potatoes have increased from about one-third of total consumption in 1968 to more than half in 1977. This increase has largely been due to the growing acceptance of frozen and dried potato products. The present U.S. composition of processed potato components is as follows: 45% frozen french fries; 22% dehydrated; 21% chips or shoestrings; and 12% miscellaneous canned, fried and frozen products.

Although both the retail store purchaser and restaurant and institutional users have increased their use of processed potatoes, the

EXHIBIT 3.11

DISTRIBUTION OF POTATOES IN THE DENVER METROPOLITAN AREA



Figures outside rectangles represent throughput in millions of pounds annually.
Figures inside circles represent inventory in millions of pounds.

TABLE 3.5

SUMMARY OF COLORADO POTATO PRODUCTION,

IMPORTS, EXPORTS AND CONSUMPTION, 1975

(MILLIONS OF POUNDS)

Type	Production	Imports	Exports	Consumption
Fresh	834	5	706	133
Processed	34	109	0	143
Total	868	114	706	276

greatest change has come in the latter group, which in 1977 used about 80% of all processed potato products. This change has been brought about primarily by the fast-food chains. There are two companies in Denver which "prepare" (fresh unfrozen) potatoes for restaurant and institutional users. However, these firms are small and supply less than 5 percent of the market. Most french fries and similar processed potato products used by the Colorado restaurant trade are prepared, packaged and frozen in Washington, California and other states by major food companies such as Del Monte and Carnation.

3.4.8 Sugar and Sweets

In 1974, Colorado ranked fifth nationally in sugar beet production, and obtained approximately 800 million pounds of sugar from 11 processing plants. Great Western Sugar, Inc. has nine plants in Colorado and produces almost 90% of he State's sugar. Based on the national average per-capita consumption of 97 pounds annually, total consumption in Colorado was 214 million pounds. This includes about 20 million pounds of cane sugar brought into Colorado from outside sources. Table 3.6 summarizes Colorado sugar production, imports, exports and consumption.

About two-thirds of the sugar consumed in the United States is contained in processed foods and drinks. The soft drink industry accounts for about one-third of the industrial sugar consumption in the nation.

Food and drink processors account for about 65 percent of Colorado's sugar consumption, about the same as the national average. Industrial sugar use in Colorado is based on the distribution (by number and size) of food and drink plants. There is a concentration of food processing plants in Denver, but beverage plants tend to be located in the general area of consumption. The volume of sugar throughput and estimated inventory at various points in the distribution process is shown in Exhibit 3.12.

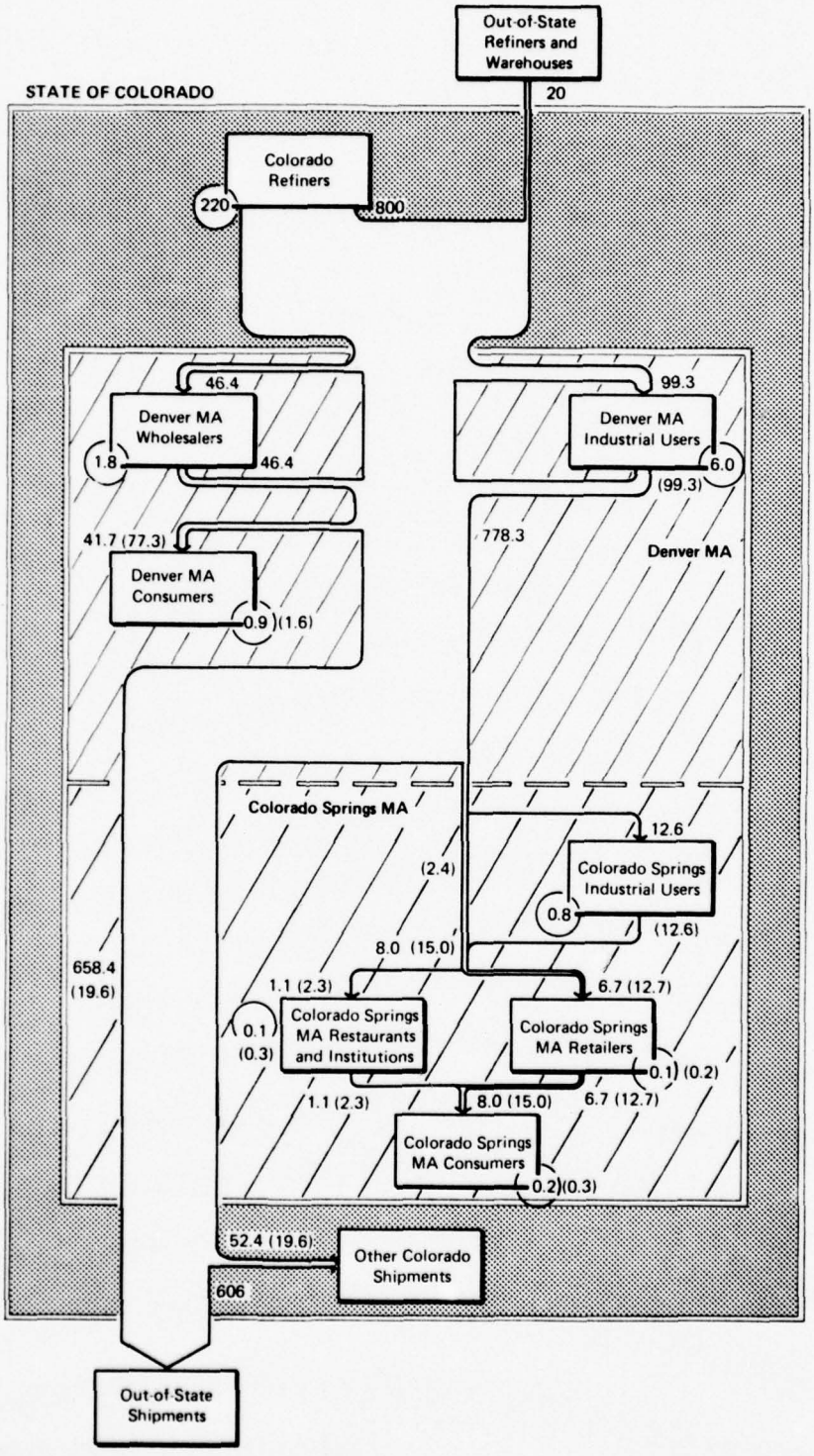
TABLE 3.6

SUMMARY OF COLORADO SUGAR PRODUCTION, IMPORTS, EXPORTS, AND CONSUMPTION

Item		Quantity (Millions of Pounds)
Production		800
Imports		20
Exports (shipped out of State)		606
Consumption		
Denver SMSA	119	
Colorado Springs SMSA	23	
Other Colorado	72	
Total Consumption		214

EXHIBIT 3.12

DISTRIBUTION OF SUGAR AND SWEETS IN DENVER AND COLORADO SPRINGS M.A.



Figures outside rectangles represent throughput in millions of pounds annually.
Figures inside circles represent inventory in millions of pounds.
(000) Sugar identity lost in locally processed foods.

4. POSTATTACK SITUATION ANALYSIS

To provide a basis for assessing the probable postattack adequacy of the recent reconfigured Colorado food distribution system, each element of the distribution system underwent a damage assessment analysis. The results of this damage assessment were applied to the preattack commodity-flow model to predict the probable postattack flow of the selected food groups to host-area survivors. Alternative postattack distribution strategies capable of meeting the requirements based on USDA National Emergency Consumption (NEC) standards were postulated and evaluated, and promising strategies were examined for components which could be incorporated into the preattack guidance for the relocation effort. This chapter discusses the results of the damage assessment analysis on a commodity-by-commodity basis.

4.1 NATIONAL EMERGENCY CONSUMPTION STANDARDS

Following discussions with food industry personnel, USDA officials, and disaster assistance agencies, the National Emergency Food Consumption Standards developed by the USDA were adopted as standards to be met under conditions of crisis relocation. It is generally recognized that these standards -- which are listed in Table 4.1 -- are far from austere,[3] and that the population might subsist for short periods on more limited supplies. Nonetheless, the decision was made to use these standards as a yardstick to measure food requirements throughout the study.

There are several arguments for using these standards:

1. They are well recognized and widely accepted;

2. They deal with common units of individual commodities; and

3. They approximate a normal diet -- hence, if the food distribution system of an urban area can be altered to meet the standards in supplying evacuees, there is little danger of citizen outrage.

The National Emergency Consumption Standards provide a consistent basis for evaluating alternative distribution systems. Furthermore, since the recommended consumption levels in pounds per week roughly approximate current consumption levels (the emergency standards represent an equiva-

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[3]In fact, the designation National Emergency Consumption Standards was changed in 1976 to National Emergency Maximum Food Distribution Allowance, presumably to emphasize the fact that these quantities reflect an upper limit on consumption in times of emergency, rather than the bare minimum required for survival.

TABLE 4.1

COMPARISON OF NATIONAL EMERGENCY FOOD CONSUMPTION STANDARDS

AND 1975 WEEKLY PER CAPITA CONSUMPTION LEVELS

Food Groups and Food Items	Amount Per Week	
	National Emergency Standards	1975 Consumption Levels
Meat and meat alternates (red meat, poultry, fish, shellfish, cheese, dry beans, peas, and nuts)	3 lbs.	4.5 lbs.
Eggs	6 (0.78 lbs.)	5.3 (0.69 lbs.)
Milk (fluid, whole)	7 pints (7.53 lbs.)	4.6 pints (4.97 lbs.)
Cereals and cereal products (flour including mixes, fresh bakery products, corn meal, rice, hominy, macaroni, and breakfast cereals)	4 lbs.	2.4 lbs.
Fruits and vegetables (fresh and frozen)	4 lbs.	5.7 lbs.
Food fats and oils (butter, margarine, lard, shortening, and salad and cooking oils)	0.5 lbs.	1.0 lbs.
Potatoes (white and sweet)	2 lbs.	2.4 lbs.
Sugars, syrups, honey, and other sweets	0.5 lbs.	2.3 lbs.
TOTAL (Equivalent Pounds Per Week)	22.31 lbs.	23.96 lbs.

lent of 22.31 pounds per week per person, as compared with the 23.96 pounds consumed per person in 1975), the adoption of these levels permits many direct comparisons with the capacities and inventory levels in the existing distribution system. On an individual basis, NEC standards are higher than current levels for such items as milk and cereal, but considerably lower for sugar and food fats and oils.

4.2 DAMAGE ASSESSMENT

4.2.1 Population

The savings in lives resulting from the relocation of the risk-area population has been briefly discussed in an earlier section. On the national level, it is expected that the implementation of the crisis relocation strategy will save an additional 70 million persons as compared to in-place protection. A comparison of additional lives saved under crisis relocation for the Colorado Springs risk area is presented in Table 4.2. A conservative estimate places the number of critical workers at 4,801, and it is assumed that 50% of these will be in the risk area at the time of the attack. Table 4.3 shows the total population within the risk and host areas after the attack. Total postattack emergency food requirements for Colorado risk and host areas are shown in Table 4.4.

4.2.2 Food

Damage assessment for agriculture, processing, storage and distribution are discussed briefly in the following sections, and overall survival rates of the U.S. and Colorado are compared. A more detailed discussion of the subject and information on specific commodities and facilities is provided in Section 4.4, Postattack Food Distribution.

For purposes of analyzing damage to agricultural production and food storage, the unclassified attack pattern "UNCLEX CHARLIE-73" was used. This attack pattern (along with "UNCLEX MIKE-73") was developed in 1973 by the Federal Preparedness Agency (FPA), General Services Administration, as a moderately heavy attack well within the current-offensive capabilities of countries with nuclear weapons. The date of the attack for the facility and livestock analysis was late March 1973. For a crop analysis, FPA ran the attack on two additional dates (June 1 and August 1), so that USDA could analyze the effects during the major growing seasons. Weapon sizes ranged from 3 to 20 megatons (MT), with 43% being 3 MT and 45% 5 MT. All weapons were ground bursts, except those directed at railroad bridges which were air bursts with 10 P SI peak overpressure. The attack pattern included about 1,160 weapons assigned to military, civilian and industrial targets, concentrating most heavily on civilian and industrial targets. The results of this work were summarized by the USDA (Reference 41) and used to update its stand-by plans.

TABLE 4.2

COLORADO SPRINGS RISK AREA POPULATION SURVIVAL

WITH AND WITHOUT CRISIS RELOCATION

Category	Percentage	Without Relocation (131,521 Persons in Risk Area)	With Relocation (2,401 Critical Workers in Risk Area)
Killed			
Blast	64.70	85,094	1,553
Radiation	1.19	1,565	29
Subtotal	65.89	86,659	1,582
Injured			
Blast	22.76	29,934	546
Radiation	0.79	1,039	19
Blast and Radiation	4.40	5,787	106
Subtotal	27.95	36,760	671
Uninjured	6.16	8,102	148
TOTAL	100.0%	131,521	2,401

Source: DCPA Survival Rate Data and SYSTAN analysis.

TABLE 4.3

COLORADO SPRINGS RISK AREA AND HOST AREA POPULATION IN THE POSTATTACK PERIOD

Category	Host Area Resident Population	RELOCATEES				Total Risk and Host Area Population
		Non-Critical Worker Relocatees in Host Area	Critical Workers in Host Area at Time of Attack	Critical Workers in Risk Area at Time of Attack	Total Relocatees	
Relocatees						
Total Relocatees		126,719	2,401	2,401	131,521	131,521
Less Killed				1,582	- 1,582	- 1,582
Injured				671	671	671
Uninjured		126,719	2,401	148	129,268	129,268
Injured & Uninjured Relocatees		126,719	2,401	819	129,939	129,939
Host Area Resident Population	77,456					77,456
Total Risk & Host Area Population in Post-Attack Period	77,456	126,719	2,401	819	129,939	207,395

NOTE: Total risk area population is 217,707 (86,186 military personnel and dependents, not included in planning, and 131,521 relocatees). It is assumed that injured persons will be moved to the host area subsequent to an attack.

TABLE 4.4

POSTATTACK FOOD REQUIREMENTS FOR COLORADO RISK AND HOST AREA POPULATION BASED ON NATIONAL EMERGENCY FOOD CONSUMPTION STANDARDS

(Critical Worker Assumption No. 2)

Food Groups and Food Items	Per Capita National Emergency Standards (Weekly Basis)[1]	Risk & Host Area Postattack Food Requirements (000 lbs.)	
		Weekly Basis	Annual Basis
Meat and meat alternates (red meat, poultry, fish, shellfish, cheese, dry beans, peas and nuts)	3 lbs.	617.0	32424.6
Eggs	6 (0.78 lbs.)	160.4	8428.2
Milk (fluid, whole)	7 pts. (7.53 lbs.)	1548.8	81448.0
Cereal and cereal products (flour including mixes, fresh bakery products, corn meal, rice, hominy, macaroni, and breakfast cereals)	4 lbs.	822.7	43245.1
Fruits and vegetables (fresh and frozen)	4 lbs.	822.7	43245.1
Food fats and oils (butter, margarine, lard, shortening, and salad and cooking oils)	0.5 lbs.	102.8	5410.2
Potatoes (white and sweet)	2 lbs.	411.4	21641.0
Sugar, syrups, honey, other sweets	0.5 lbs.	102.8	5410.2
TOTAL (Equivalent Pounds Per Week)	22.31 lbs.	4588.6	241252.4

[1]Source: U.S. Department of Agriculture Food Order Number 2.

[2]Assuming a population of 207,395

The UNCLEX CHARLIE attack pattern was also used for an assessment of postattack accessibility of food processing plants. In this computer analysis, however, FPA utilized the Bureau of Census "value of shipments" data (four-digit SIC level) rather than the number of plants so a closer approximation of remaining capacity could be obtained (Reference 42).

4.2.2.1 Agriculture.

Table 4.5 compares U.S. agricultural survival rates with those of Colorado. It can be seen that the average survival rates for the U.S. as a whole and for Colorado are similar for most commodities.

4.2.2.2 Processing.

In general, the Colorado food processing industry did not fare as well as the total industry on a nationwide basis. In the case of some commodities, such as sugar, however, Colorado suffered less damage. This is partly due to the vulnerability of the nation's cane refineries, many of which are located along coasts or inland waterways near target areas (see Table 4.5).

4.2.2.3 Storage.

Most of the U.S. and Colorado storage facilities for such special commodities as potatoes and grain are located outside the high-risk areas and, thus, survival rates are generally high (Table 4.5).

4.2.2.4 Distribution.

Food chain and wholesale warehouses on a national basis survive much better than they do in Colorado. Forty-six percent[4] of the total number of wholesale food warehouses survived nationally, whereas only 5 percent of the wholesale warehouse capacity survived in Colorado. One reason for this is a greater proportion of Colorado food goes through chains

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[4]This nationwide estimate reflects the percentage survival of the total number of wholesale warehouses in the U.S. without regard for warehouse capacity. Since the larger warehouses tend to be located in high-risk areas, the percentage of surviving warehouse capacity is undoubtedly much lower. Estimates of damage to nationwide warehouse capacity were not available through FDA. However, SYSTAN prepared such estimates for the State of Colorado.

TABLE 4.5

COMPARISON OF NATIONWIDE AND COLORADO AGRICULTURAL PRODUCTION, FOOD PROCESSING AND STORAGE PERCENTAGE SURVIVAL

COMMODITY GROUP	NATIONWIDE			COLORADO		
	Production Capability (Percent Surviving)	Processing Capability (Percent Surviving)	Storage (Percent Surviving)	Production Capability (Percent Surviving)	Processing Capability (Percent Surviving)	Storage (Percent Surviving)
Meat	63	47		64	46	
Milk	57	46		70	11	
Eggs	54	68		50	5	
Cerals and Cereal Products	48-82[1]	31	83[2]	78	10	85
Fruits and Vegetables	75	63		76	46	
Food Fats and Oils	100-35[1]	49		60	5	
Potatoes	45-82[1]	73	85[2]	91	10	95
Sugar	45-82[1]	49		66	73	
Total[4]	N.A.	45		N.A.	39	

[1] Damage is light if attack occurs any time other than in the early growth and reproductive stages. If an attack occurs when the crop is in the vulnerable stage (around early June) damage will be moderate to heavy. Heaviest damage to soybeans is in August.

[2] Food grain stocks at D+15 (wheat, rice and edible beans). This would increase to 94% accessibility by D+60.

[3] This is considered to be a conservative estimate. No specific data on potato storage is available; however, the USDA/ASCS report referenced below indicates that 100% of the refrigerated warehouses in rural areas would be accessible at D+30. Most potatoes are stored in the growing areas.

[4] Total includes miscellaneous categories.

Source: USDA/ASCS, Analysis of U.S. Food Industry in A National Emergency, Washington, D.C., July 1977; General Services Administration, Federal Preparedness Agency, Summary Analysis of Scheduled Availability for Production (SASAP Attack UNCLEX-CHARLIE, Category MSI, Manufacturing Establishments, National Summary, Washington, D.C., October 1977.

with warehouses in Denver than is the case in many other U.S. cities. Another, possibly more important distinction reflects the difference between the relative number of warehouses surviving and surviving warehouse capacity (see footnote).

4.3 POSTATTACK FOOD INVENTORIES

The immediate postattack availability of food to survivors in the Colorado Springs host area is summarized in Table 4.6. This table itemizes the inventories of each critical commodity held by area processors, wholesalers, restaurants, retailers, and consumers before and after the postulated attack. Retail inventories include foodstuffs shipped from risk area wholesalers during the relocation period. In addition, consumer inventories include those foodstuffs transported by risk-area residents traveling by automobile to the host area. Commodity holdings are expressed both in common sales units and in terms of the time required to deplete preattack and postattack inventories. Postattack depletion times were calculated by assuming that survivors would subsist on the weekly rations identified in the National Emergency Consumption Standards (Table 4.1).

Table 4.6 identifies fluid milk as a critical commodity which is likely to last less than one week following a nuclear attack on the Colorado Springs metropolitan area. Shortages of meat, eggs and processed cereals may also be expected during the second week. Fruits and vegetables will also be in short supply until distribution channels can be reestablished with the nearby producers and out-of-state suppliers. The depletion times for fats and oils exceed three weeks, and those of sugar forty-eight weeks. It should be noted that for most commodities, overall depletion times have been substantially extended because of the foodstuffs carried to the host-area relocatees and, in addition, the diversion of supplies by risk-area wholesalers to host-area retail stores.

4.4 POSTATTACK FOOD DISTRIBUTION

This section sets forth general postattack survival of food supply and processing activities at the national and local (Colorado) levels. Several possible alternative sources of action are then described to rectify supply/demand imbalances using Colorado data for purposes of illustration.

TABLE 4.6: PREATTACK AND POSTATTACK COMMODITY INVENTORIES
COLORADO SPRINGS RISK AND HOST AREA
(MILLIONS OF POUNDS)

	PROCESSORS	WHOLESALE AND COLD STORAGE WAREHOUSES	RESTAURANTS AND INSTITUTIONS	RETAILERS*	CONSUMERS+	TOTAL INVENTORY	GRAIN AND POTATO STORAGE	DEPLETION TIME (IN WEEKS)
Meat & Meat Alternatives								
Preattack	0.537	0.625	0.060	0.500	0.440	2.162		2.34
Postattack	0.026	0.019	0.020	0.500	0.370	0.935		1.52
Milk & Dairy Products								
Preattack	0.278	0.019	0.133	0.400	0.660	1.490		1.46
Postattack	0.031	0.002	0.030	0.400	0.420	0.883		0.57
Eggs								
Preattack	0.012	0.096	0.040	0.070	0.150	0.368		2.59
Postattack	0.002	0.005	0.010	0.070	0.110	0.197		1.23
Cereals & Cereal Products								
Preattack	2.740	0.802	0.133	0.270	1.050	4.995	4.200	18.63
Postattack	0.056	0.040	0.030	0.270	0.950	1.346	3.500	5.89
Fruits & Vegetables								
Preattack	0.011	0.615	0.133	0.660	1.590	3.009		2.57
Postattack	0.005	0.031	0.030	0.660	0.870	1.596		1.94
Food Fats & Oils								
Preattack	0.000	0.280	0.133	0.130	0.400	0.943		4.58
Postattack	0.000	0.014	0.303	0.130	0.220	0.394		3.79
Potatoes								
Preattack	0.014	0.280	0.133	0.130	0.500	1.057	270	549.14
Postattack	0.005	0.014	0.030	0.130	0.480	0.659	270	657.60
Sugar & Sweets								
Preattack	5.686	0.160	0.133	0.130	0.400	6.509		13.76
Postattack	4.492	0.008	0.130	0.130	0.220	4.980		48.44

* Postattack figures represent after relocation of inventory levels.

+ Includes food transported by risk area evacuees traveling by auto to host area.

4.4.1 Meat and Meat Alternates

4.4.1.1 National Situation.

At the national level, it is estimated that approximately 47 percent of the meat processing capacity would be accessible 30 days after the postulated attack.[5] About 63 percent of the animal supply (on a weight basis) would be accessible.

4.4.1.2 Colorado Situation.

In Colorado, the percentage survival of meat packing and processing capability is about the same as the national average. The relative survival of the meat, poultry and fish supplies and the meat packing plants serving Colorado is depicted in Exhibit 4.1. It can be seen that preattack Colorado sources of meat, poultry and fish will have difficulty in satisfying postattack requirements, primarily because of the destruction of the meat packing and processing industry in Colorado. It is estimated that immediately following the postulated attack, over 90 percent of the State's meat packing/processing capability would be destroyed or inaccessible. Within four to six weeks, however, 46% of the normal capacity would be available. Supplies of slaughtered animals and carcasses, however, would exceed postattack processing capabilities, since it is estimated that 64% of the animal supply (on a weight basis) would survive.

Three major meat-packing firms are located in Logan and Morgan Counties. Fallout radiation would probably prevent workers from re-entering the plant in Logan County for about four months. However, the radiation from fallout in Morgan County would be much less, and workers could probably return to the beef-packing plant in Fort Morgan and the hog-packing plant in Brush in four to six weeks.

There are two medium-size beef-packing plants in Grand Junction and Delta. These would be virtually unaffected by blast or fallout effects of the postulated attack, and would continue to function. These firms may slaughter 70 to 100 animals per day. Both of these firms indicated that they could double or triple output under emergency conditions.

Small firms which do slaughtering may be divided into slaughtering and packing, and frozen-locker operations. Small slaughtering plants may slaughter 10 to 35 cattle and a similar number of hogs each week. The meat may be sold locally or shipped out of the county. The small slaughtering firms in Grand Junction serve stores in that area. Most of these plants indicated that they could triple their output under emergency conditions. Frozen-locker operations also usually engage in slaughtering, but usually on a smaller scale (fewer than ten beef per

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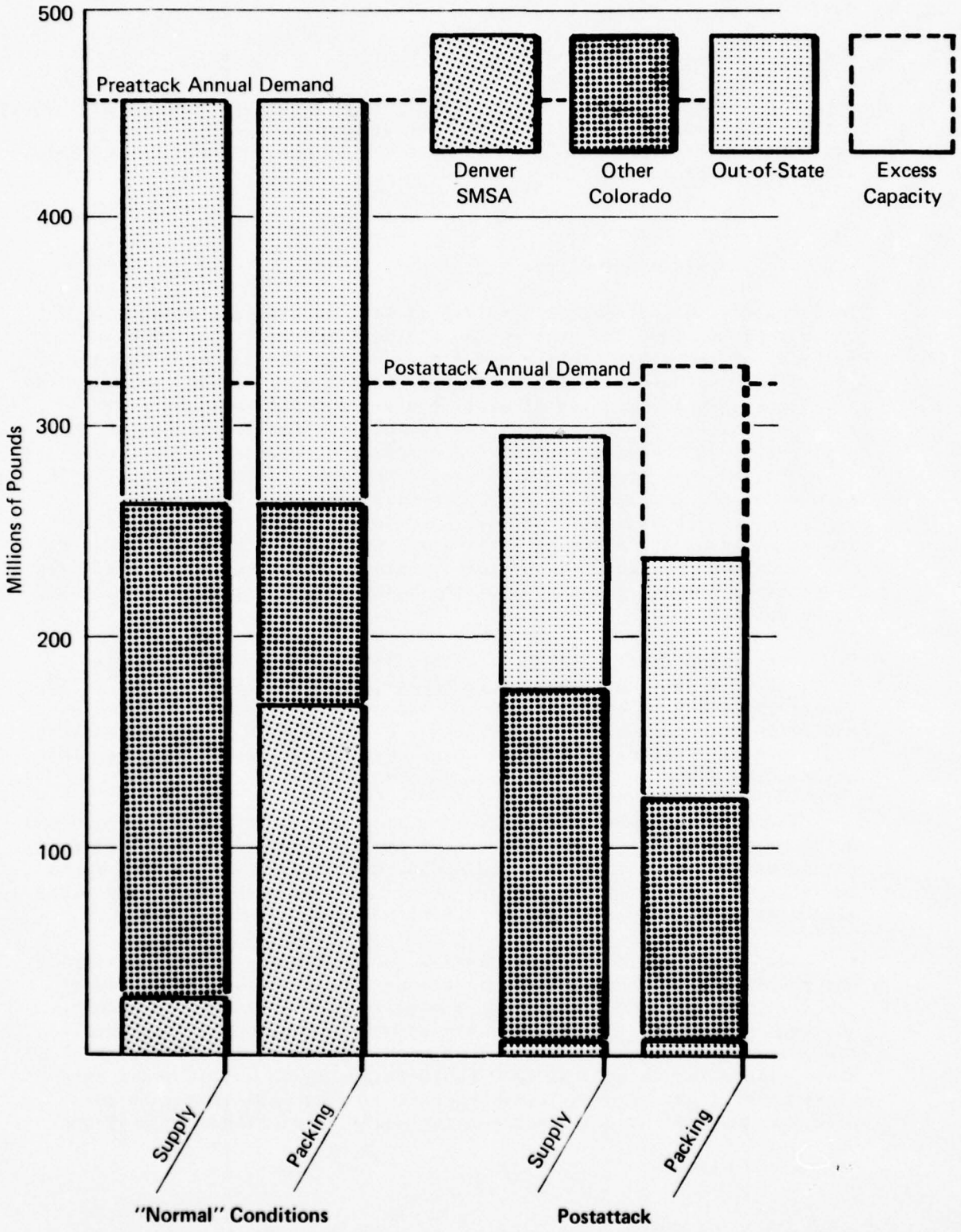
[5]Data based on Federal Preparedness Agency UNCLEX Charlie attack.

EXHIBIT 4.1

SURVIVAL OF SUPPLIERS AND PACKERS OF MEAT, POULTRY AND FISH IN COLORADO



week and also possibly some hogs). Most of these firms indicated they could about double their operations under emergency conditions.

Colorado meat consumption under normal conditions is 456 million pounds per year. Using NEC standards, Colorado's estimated postattack meat requirements are 339 million pounds on an annual basis. The immediate postattack period (with emergency meat production at the rate of approximately 145 million pounds) would be the most critical time, with only about 10% of normal production. Within four weeks, however, fallout radiation will have subsided sufficiently to allow production at the American Beef Packing Company near Fort Morgan and the Sigman Meat Company at Brush to resume production. At emergency operating levels, production could reach 653 million pounds, or about 46% of normal preattack production.

Within four months, radiation levels at the Sterling plant should be low enough to permit resumption of production and this major addition to Colorado meat-packing and -processing would bring annual production to 1,200 million pounds, or about 84% of the preattack production level. The production of 1,200 million pounds would exceed emergency consumption requirements (1,058 million pounds).

4.4.1.3 Emergency Construction of Processing Facilities.

Expansion of Existing Facilities. Generally, expansion of output of existing meat-packing facilities is preferable to building new ones, since the basic structure, the equipment and the core personnel are already in-place. A plant of moderate size, which under normal conditions processes 100 to 200 cattle and 50 to 100 hogs per day, can often expand to 600 cattle and 300 hogs under emergency conditions. This would mean reducing processing activities to cooling and quartering. Cooling would be for 24 hours only; none of the usual aging process, cutting to steaks, etc. or smoking of hogs would take place. The dressed weight of meat output on this basis would be 154 million pounds per year. A facility of 26,000 square feet could accommodate this level of throughput. It is assumed that at this level of throughput, there would be two shifts with 70-80 workers on each shift.

New Facilities. If a facility such as that described above were not available, a facility which would permit an equivalent throughput could be built for the costs listed in Table 4.7.
This type of building could be constructed under emergency conditions in six weeks or two months if equipment and materials were available. The manning level would be 70-80 workers for each of two shifts.

If two new plants were constructed, each processing 600 cattle and 300 hogs per day (154 million pounds dressed meat per year), emergency production would be increased from 62% of emergency requirements to approximately 91% of emergency requirements.

TABLE 4.7: EMERGENCY MEAT-PROCESSING FACILITY CONSTRUCTION COST

Item	Cost
Building area (including loading docks), 13,000 sq.ft. @ $7/sq.ft.	$91,000
Cooling trailers, 15 @ $22,500 each	337,500
Kill room equipment	50,000
Other equipment	50,000
Total	$528,500

It appears that Colorado's postattack meat-processing needs can be met by expanding surviving facilities (see Exhibit 4.1), so that the emergency construction of new packing facilities will not be necessary in that State.

4.4.1.4 Summary of Options.

Meat and meat alternates supply and processing options are discussed in this subsection.

Preattack Options

1. Increasing Production and Stockpiling in the Crisis Relocation Period: This option is possible, but is limited in overall effectiveness because meat products which can be stored without refrigeration constitute only an estimated 5 to 6 percent of total meat consumption. Overall production could probably be increased an estimated 40-50 percent assuming that containers were available.

2. Individual Firms Prepare Plants for Expanded Output in the Postattack Period: Planning for internal changes required for expanded output would permit shorter start-up time after the postulated attack.

Postattack Options

1. Increasing Output of Surviving Packers and Processors: By using refrigeration capacity for cooling and eliminating aging and most processing activities (such as production of specialized products), the industry could increase output by at least 50 to 75 percent.

2. Expansion of Existing Facilities: In some meat packing and processing plants, especially those medium- size and smaller, considerable potential excess capacity exists. In order to utilize this potential capacity, however, plant space utilization changes may be necessary, and additional equipment such as refrigeration units must be added. Semi-trailers equipped with refrigeration units could serve as supplemental cooling space.

3. Construction of New Packing and Processing Facilities: A temporary emergency packing facility using semi-trailers or other portable units for cooling could be constructed in about six weeks. Such a facility could supply approximately one-third of Colorado's postattack emergency meat requirements, and could be constructed for between one-half and three-quarter million dollars.

4.4.2 Milk and Milk Products

From a nutritional standpoint, milk is one of the most important of the eight USDA food groups. Past research has shown that milk is likely to be the food commodity in shortest supply following a nuclear attack.

The relative survival of Colorado dairy farms and fluid milk processors is shown in Exhibit 4.2. This figure shows that about 70% of the milk production capacity would survive the postulated attack, but that only 11% of the processing capability would be available. In addition, milk consumption (based on NEC standards) would be higher during the postattack period than during the preattack period. The surviving fresh milk processing plants and the evaporated milk plant operating at preattack levels could supply only about 8% of the postattack annual demand. However, several alternative courses of action could be implemented to substantially increase the supply of milk to Colorado residents during the postattack period. These alternatives are noted below and discussed in the following subsections.

1. Increasing evaporated milk output;

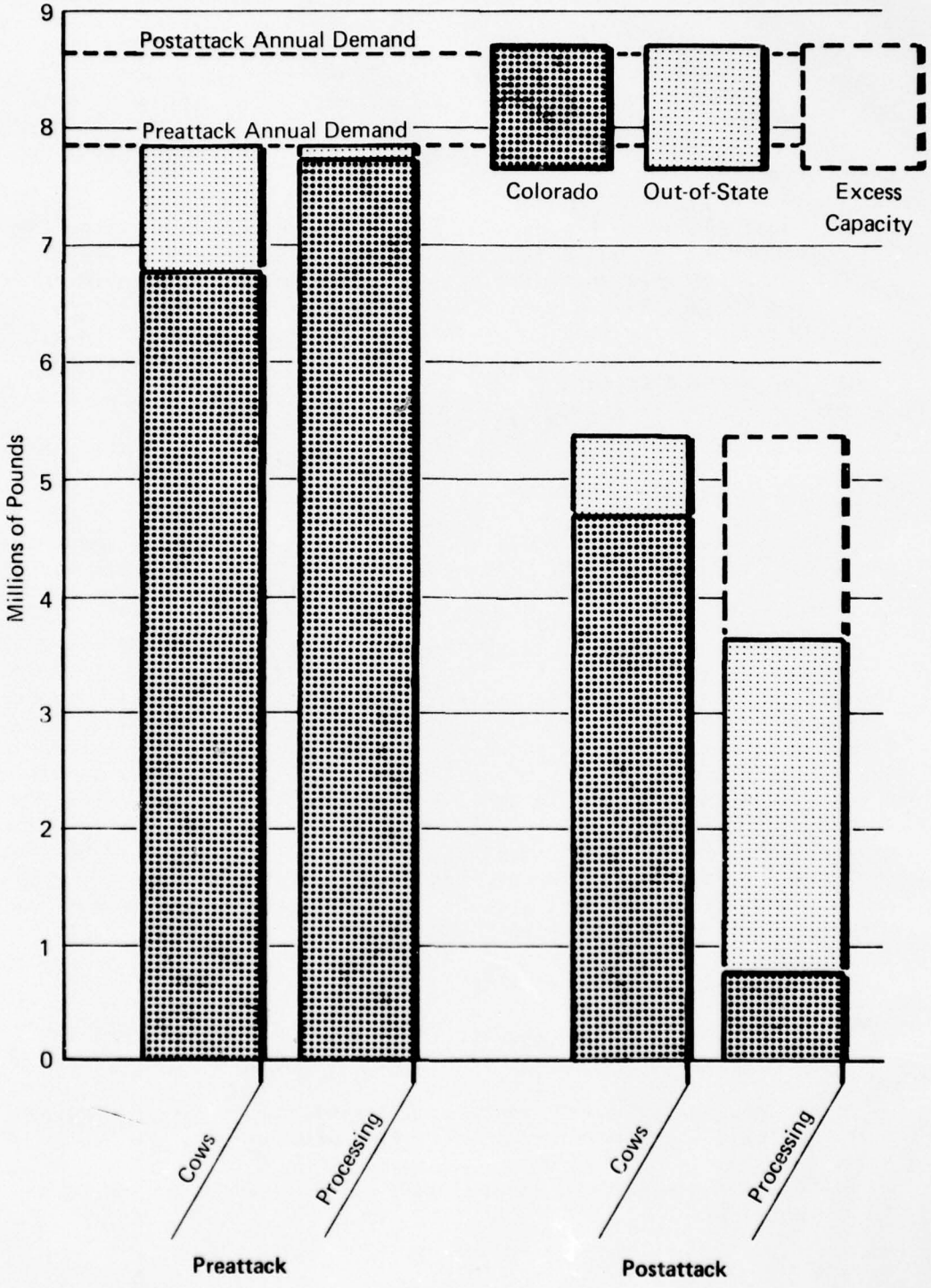
2. Substituting dried milk for fluid whole milk (by increasing out-of-state processing and using USDA/ASCS inventory);

3. Expanding fluid milk processing capability (expanding output of existing plants and constructing new plants); and

4. Diverting milk into manufactured dairy products to increase shelf life.

EXHIBIT 4.2

SURVIVAL OF MILK COWS AND FLUID MILK PROCESSORS SERVING COLORADO



4.4.2.1 Increasing Evaporated Milk Output.

Canned evaporated milk can be an appropriate substitute for fresh milk under emergency conditions. It does not require refrigeration and can easily be transported.

U.S. Production and Distribution. Total U.S. production of evaporated milk in 1976 was 885,747,000 pounds (20,362,000 cases at 43.5 pounds per case). In order to meet the standards of the Evaporated Milk Association, evaporated milk must contain 7.5% milk fat and 25.5% milk solids including milk fat.

The two largest producers in the U.S. are the Carnation Company and Pet, Incorporated. A list of names and locations of U.S. plants is shown in the Guidelines section of this report. Overall, there are a total of 23 canning plants and 12 receiving stations.

The demand for evaporated milk has been declining gradually over the past several years by an average of about 5% per year from 1971 to 1976, due partly to the increased use of dried milk and cream substitutes in coffee. The Evaporated Milk Association estimates that overall U.S. production could be at least doubled with the present plant by adding more shifts and seven-day work weeks, provided that sufficient containers and milk are available. However, the possible increase in capacity varies considerably from one plant to another. Some plants could probably not increase production with their present facilities by more than 60% to 70%.

Colorado Production and Distribution. There is one evaporated milk plant in Colorado, owned and operated by the Carnation Company. This plant is located in Johnstown, Weld County, which is outside the Greely and Denver-Boulder high-risk areas.

The Carnation plant produces milk in standard 13-ounce cans under the Carnation label, and also King Soopers and various other brand names. Production from this plant accounts for about 75% of the market. Other evaporated milk producers ship canned milk into Colorado in various size containers, including the standard 13-ounce size, 5-1/2 ounce size, and the Number 10 can size (about one gallon). The latter size is primarily for the restaurant and institutional market.

Production at the Johnstown plant averages about 100,000 pounds of whole fluid milk input per day, although there is wide variation from day to day and from season to season. The volume of fluid milk received by the plant increases considerably during the summer months when school is out. In addition, the amount increases on holidays when whole milk consumption decreases. The plant has a capacity considerably greater than the present production -- probably about 500,000 pounds per day if additional shifts were implemented.

The ratio of fluid milk input to evaporated milk output is about 2.11 to 1. That is, a 44-pound case of evaporated milk would require about 93 pounds of whole fluid milk as input to the manufacturing

process. Thus, the daily average of 100,000 pounds of fluid milk which is processed would result in 47,393 pounds of evaporated milk. On a five-day per day basis, 50 weeks per year, the plant would have an input of 25 million pounds of fluid milk per year. If the plant operated at its 500,000 pound per day capacity, six days per week, the total fluid milk input would be 150 million pounds per year.

Colorado's total fluid milk production is about 672 million pounds per year and, with present imports, total fluid milk consumption is about 768 million pounds per year. The evaporated milk plant input of 150 million pounds of fluid milk per year would be about 22.3% of Colorado's fluid milk production, or 19.5% of Colorado's total fluid milk consumption under normal conditions. Thus, a substantial portion (22.3%) of Colorado's milk production could be processed into evaporated milk under emergency conditions. The production and consumption of fluid and evaporated milk in Colorado is summarized in Exhibit 4.3.

Storage (Inventory) at Plant. There is considerable variation in plant inventory. There may be 400,000 pounds on hand toward the end of the summer; at other times of the year, there may be practically none.

4.4.2.2 Substituting Dried Milk for Fluid Whole Milk.

Dried milk may be stored without refrigeration, is easily transported, and has only a fraction of the bulk of whole fresh milk.

Dried Milk Processing in the United States. There are a large number of milk-drying plants operating in various states. The greatest capacity, of course, generally exists in those states which are high in fresh milk production. Some of the states with the largest total drying capacity are California, Wisconsin, Washington, Minnesota and Missouri. These plants are generally very large, and hence are costly and time-consuming to build. An average-size plant may have a capacity of 300 to 400 thousand pounds per day of fluid milk input, resulting in 30 to 40 thousand pounds per day of dried milk output.

Production of dried milk is highest in the spring and early summer months, when milk production is at its peak. In addition, there is an excess of milk in many areas during the summer months, when children are out of school, as the school lunch programs requires a considerable volume of fresh milk. The plants produce dried milk only when there is an excess of milk which is not used in direct fresh milk or cream consumption or manufactured into cheese, ice cream or other dairy products.

Available excess capacity at dried milk plants varies considerably from one part of the country to another. During the early spring and early summer months, milk is often shipped from one state which does not have excess drying capacity at that time to another which does. Foremost McKesson, which has several drying plants in various parts of California, ships milk to drying plants in Idaho Falls and Caldwell, Idaho when its California drying plants are operating at capacity. Milk is

EXHIBIT 4.3

ESTIMATED PRODUCTION AND CONSUMPTION OF FLUID AND EVAPORATED MILK IN COLORADO, 1975 (MILLIONS OF POUNDS)

ITEM	Fluid Milk Production	Evaporated Milk Production		
		Fluid Milk Input		Evaporated Milk
		Volume	% of Total Fluid Milk	
Normal Production				
Colorado Production	672.00	25.00[1]	3.72	11.85
Imports	96.00			
Total Consumption	768.00	25.00[1]	3.26	11.85
Potential Capacity of Evaporated Milk Plant Under Emergency Conditions (CRP)				
Colorado Production	672.00	150.00[2]	22.32	71.09
Imports	96.00			
Total Available for Consumption	768.00	150.00[2]	19.53	71.09
Potential Capacity of Evaporated Milk Plant Under Postattack Conditions				
Colorado Production[3]	468.00	150.00[2]	32.05	71.09[5]
Imports[4]	--		---	
Total Available for Consumption	468.00	150.00[2]	32.05	71.09

[1]Input based on 100,000 pounds per day, five days per week, 50 weeks per year.

[2]Input based on 500,000 pounds per day, six days per week, 50 weeks per year.

[3]Unprocessed production; i.e., raw milk.

[4]It is assumed that there are no imports.

[5]The ratio of fluid milk to evaporated milk on a volume basis is approximately 2.11 to 1.

cooled at the producing dairy to about 39 degrees Fahrenheit, is sent to collecting points, and is then transported in insulated tank trucks to the drying plants. Milk can be transported up to 1,000 or 1,500 miles in an insulated tank truck with an increase of only two degrees over the length of the trip. The milk is not processed in any way before arriving at the drying plant.

Dried Milk Processing for Colorado Milk. Colorado has no dried milk processing plants, and since Colorado is not a milk surplus area, it would not be economically feasible to build a plant there. Milk produced by Colorado's dairies, however, could be shipped in insulated tank trucks to dried milk plants in nearby states. Two such states having plants with ample dried milk capacity are Utah and Idaho.

Utah has five dried milk plants -- two in Ogden (within the risk area) and one each in Logan, Smithfield and Richmond (all north of Salt Lake City outside the risk area). These plants average 300,000 to 400,000 pounds of fluid milk input per day. Generally, they do not operate at capacity. During most of the year, they process (dry) whey, a byproduct of the cheese-making process, rather than produce dried milk. There is not sufficient surplus milk most of the year to keep the plants busy. In addition, the Environmental Protection Agency (EPA) now prohibits the discharge of whey into the sewage system; hence, it is dried and used for animal feed.

The farmers and dairy manufacturers make choices based on the price of various products. When the price of cheese is high, milk is made into cheese rather than dried milk.

The companies owning the dried milk plants in Utah and Department of Agriculture officials see no problem is drying Colorado milk during times of emergency in view of the excess capacity noted above. In addition, EPA could eliminate the restrictions on discharging whey into the sewage system during an emergency, and milk-drying could go on at full speed.

As indicated above, Colorado's milk production totals 672 million pounds per year. Any one of the three drying plants outside the risk area north of Salt Lake City could dry all of Colorado's fresh milk production by devoting only one-half of its drying capacity to that task. That is, there is sufficient capacity to dry milk produced in Utah, as well as that of Colorado and other states.

There should be no problem transporting milk from Colorado to Utah. Sizeable quantities are now shipped from Utah to Colorado. The trip from Denver to Richmond, Utah is about 10 to 12 hours, and the proper temperature can readily be maintained using insulated tank trucks.

The Dairymen's Creamery Association plant at Caldwell, Idaho (outside the risk area) is the largest milk-drying plant in Idaho, with a capacity of about one million pounds of fluid milk per day; dried milk output at capacity is about 100,000 pounds per day. A Kraft cheese plant is adjacent to the drying plant and about one-half million pounds of milk per day is presently being run through the plant as part of the

cheese-making process. The whey resulting from the cheese-making process is also dried at the plant.

It is estimated that the Caldwell, Idaho plant could process all of Colorado present production in 1.2 days per week at capacity operation. Colorado's milk production under postattack conditions could be processed in less than one day (0.83 days) per week of capacity operation. Although the distance from Colorado milk-processing areas to Caldwell is greater than the distance to Richmond, Utah, there would be no problem in maintaining fluid milk at 39 to 41 degrees Fahrenheit.

USDA/ASCS Dried Milk Storage. The U.S. Department of Agriculture (USDA) Agricultural Stabilization Service has about 385 million pounds (as of February 1977) of dried milk stored at approximately 200 sites around the United States. The milk is stored in privately-owned warehouses.

Title to these dried milk stocks is held by the Commodity Credit Corporation (CCC). The CCC is a federally-chartered organization presided over by a six-member board of directors appointed by the President with the advice and consent of the Senate. The chairman of the board is the Secretary of Agriculture. The stocks held in storage are available for sale to domestic users and exporters. As noted above, only CCC -- not USDA -- exercises title control. Permission to move stock would have to come from the board. However, since the program is operated by USDA/ASCS, commodities in storage will be referred to in this report as USDA/ASCS stocks. Any state could purchase these stocks at minimum prices. After the state obtains title, it may distribute through local agencies or handle the stocks in any way it sees fit.

The quantities stored in each state are shown in the Guidelines to this report. If these nationwide stores of dried milk (385 million pounds) were converted to fluid milk by adding water at the ratio of 9 to 1, 3,465 million pounds of fluid milk would be produced. Assuming a population of 205 million, this quantity would provide an emergency ration (based on national emergency standards) for the nation for a period of approximately 5.3 days. USDA/ASCS has indicated that under emergency conditions, dried milk would be sent where needed after first satisfying the emergency needs of the state in which it is stored. The quantity of USDA/ASCS milk presently stored within Colorado (1,025,300 pounds) would be sufficient for about 3.9 days of emergency rations for the State's total population. This dried milk is stored in a privately-owned warehouse in Denver. This milk should be moved out of Denver to a storage location in the host area during the preattack crisis relocation period.

USDA/ASCS buys dried milk for storage at a set floor price and will buy all milk offered at this price. Producers, of course, sell to USDA/ASCS when the free market price drops below the floor price. It is expected that the market price will fall below the floor price during the period from April 1977 to April 1978, and that as a result USDA/ASCS will purchase an additional 200 million pounds and thus increase its dried milk in storage from 385 million to about 585 million pounds.

This would increase the national emergency supply from 5.3 days to about 8 days. It can be seen that in terms of overall U.S. requirements, the USDA/ASCS supply in storage is not large; however, the population in certain selected geographic areas could be supplied with emergency rations for a considerable period of time, or USDA/ASCS dried milk could be used to supplement fresh, evaporated and dried milk supplies from commercial markets or other sources. Those USDA/ASCS dried milk storage sites around the U.S. that are within risk areas should be identified and plans made to move such milk to new sites within the host areas during the crisis relocation period. A listing of such vulnerable sites appears in the accompanying guidelines.

4.4.2.3 Expanding Fluid Milk Processing Capability.

Expanding Processing Output of Existing Plants. Damage assessment analysis indicates that approximately 11% of the normal milk-processing capability of Colorado (three medium-size plants outside the risk areas) would survive without damage. It is estimated that the output of these plants could at least be doubled (to 22% of the normal processing capacity) by adding extra shifts and operating seven days per day.

Construction of New Processing Plants in the Host Area. Large modern milk-processing plants are complicated, costly and very time-consuming to construct. Under normal conditions, about nine months are required to obtain the equipment for such a plant. Overall construction of the plant may require 18 months or more. During an emergency, such as extended crisis or postattack situation, when it may be advisable to supplement fluid milk-processing capacity within the host areas, time is a critical factor. An alternate course of action may be the use of existing processing equipment no longer in use. In Colorado, a number of smaller milk-processing plants have been closed in recent years, and the milk diverted to new, larger, more efficient plants. Industry officials estimate that a smaller plant could be built and furnished with used equipment, or an existing plant could be put into operating condition within one month, but the availability of used equipment is a critical factor. In Colorado Springs, the Sinton Dairy purchased a quantity of used equipment from smaller dairies as these dairies went out of business. This equipment is currently stored at Sinton's Colorado Springs plant, and should be evacuated to the host area in the event of a crisis relocation.

4.4.2.4 Diverting Fluid Milk into Manufactured Dairy Products.

One of the problems in the postattack period will be the effect of fallout on food supplies. A partial solution to the milk supply problems caused by fallout may be achieved by channeling milk produced immediately following he attack into the production of manufactured dairy products. This practice would extend the storage life of the milk products, allow its radioactive content to decay, and minimize the need for

postattack refrigeration. Arrangements could probably be made to process some of the milk at the dairy farm and local small dairies. It may be possible to reactivate some of the many small fluid milk processors recently forced to shut down their processing facilities and change to storage station operation by competition from the larger processors.

4.4.2.5 Summary.

Under emergency (CRP) or postattack conditions in Colorado, several options for the supplying of milk are available. It is assumed that existing Colorado fluid milk processing capability will be severely damaged by a nuclear attack.

Preattack Options

1. Increase the Throughput of the Evaporated Milk Plant: The throughput of the evaporated milk plant at Johnstown can be increased approximately five-fold. Operating at capacity, the plant could process approximately 22% of Colorado's milk production under CRP conditions at 32% of surviving production during the postattack period.

2. Move USDA/ASCS Stores of Dried Milk to a Safe Location: The quantity of USDA/ASCS milk presently stored in Denver (1,025,300 pounds) would be sufficient for about 3.9 days of emergency rations for Colorado's total population. This dried milk is presently stored in a Denver warehouse, and should be moved to a storage location in the host area during the preattack crisis relocation period.

Postattack Options

1. Ship Unprocessed Fluid Milk to Dried Milk Plants in Nearby States: Most dried milk plants in Utah and Idaho have considerable excess capacity, probably enough to dry all of Colorado's available unprocessed fluid milk.

2. Increase Processing Output of Existing Fluid Milk Plants: Damage assessment analysis indicates that approximately 11% of the normal milk-processing capability would survive the postulated attack without damage. Plant output could be doubled by adding extra shifts and increasing the number of operating days.

3. Construction of New Processing Plants in the Host Area: Large, modern milk-processing plants are complicated, costly and very time-consuming to construct. However, industry officials estimate that, given the availability of used equipment, several smaller plants could be built or existing plants put into operating condition within one month following the attack.

4. Manufacture of Dairy Products: Channeling milk produced immediately following the postulated attack into the production of manufactured dairy products would extend the storage life of the milk products, allow its radioactive content to decay, and minimize the need for postattack refrigeration. Some of the processing could be done at local small dairies.

The above-noted options could be used individually or in combination, depending upon the existing circumstances.

4.4.3 Eggs

4.4.3.1 National Situation.

About 54% of the U.S. layer hens and about 68% of the egg wholesale capacity is expected to survive the postulated attack. Annual U.S. per-capita egg consumption has been declining in recent years, dropping to 35.3 pounds per capita in 1975, about 15% below the NEC standard of 40.6 pounds per capita per year.

4.4.3.2 Colorado Situation.

About 95% of the egg production in Colorado takes place in the three counties of Denver, Weld and Boulder. Most of the production takes place in the Denver-Greely-Boulder triangle. It is estimated that approximately half of the Colorado egg production will remain unaffected by the postulated attack (see Exhibit 4.4). It is also estimated that approximately 5% of the egg wholesale capacity would survive the postulated attack.

Approximately 35% of all eggs consumed in Colorado are brought in from out of the State. Due to the heavy reliance on local eggs, Colorado residents will experience a shortage of eggs immediately following the attack because only about 1.2 weeks' supply is expected to survive the effects of the postulated attack. This shortage will continue in varying degrees until the repair and maintenance of transportation links with out-of-state suppliers can assure Colorado survivors of a continuing supply of sufficient eggs and egg products to meet postattack requirements.

4.4.3.3 Supply Options.

Eggs supply options are limited. The relatively short keeping time of eggs rules out preattack unrefrigerated storage. Eggs could be converted to dried form during the preattack period and stored, but this does not appear to be an acceptable alternative from a benefit-cost standpoint. It appears that the egg supply will be approximately one-

EXHIBIT 4.4

SURVIVAL OF EGG SUPPLIERS IN COLORADO

half the NEC requirements in the immediate postattack period, and that other foods will have to serve as substitutes for fresh eggs.

4.4.4 Cereals

4.4.4.1 U.S. Situation.

Data based on the UNCLEX Charlie attack indicate that 48% of the U.S. wheat crop would survive if the attack occurred on June 1 and 82% if it occurred on August 1.

In addition to flour, the chief ingredients of bread are water, yeast, sugar and salt. Of these ingredients, yeast is the most vulnerable to nuclear attack. Most large bakeries use a perishable compressed yeast, which must be kept under refrigeration and replenished every few days. There are fewer than 20 compressed yeast plants in the U.S., and most of these are owned by three major producers (Standard Brands, Red Star, and Budweiser). A substantial portion of the U.S. yeast productive capability would be damaged during the postulated attack; however, a sufficient number of the plants are outside the high-risk areas with enough production to allow surviving bakeries to operate, once interstate transportation and electricity for refrigeration have been restored. Small stockpiles of dry yeast would help reduce yeast shortages during the immediate postattack period (Reference 12).

Data based on the UNCLEX attack indicate that 31% of the milling capability of flour and other grains in the nation at large could be expected to survive. Shortages of manufactured flour may be expected in the immediate postattack period while the necessary adjustments are being made, but there will be enough whole grains to last several months.

4.4.4.2 Colorado Situation.

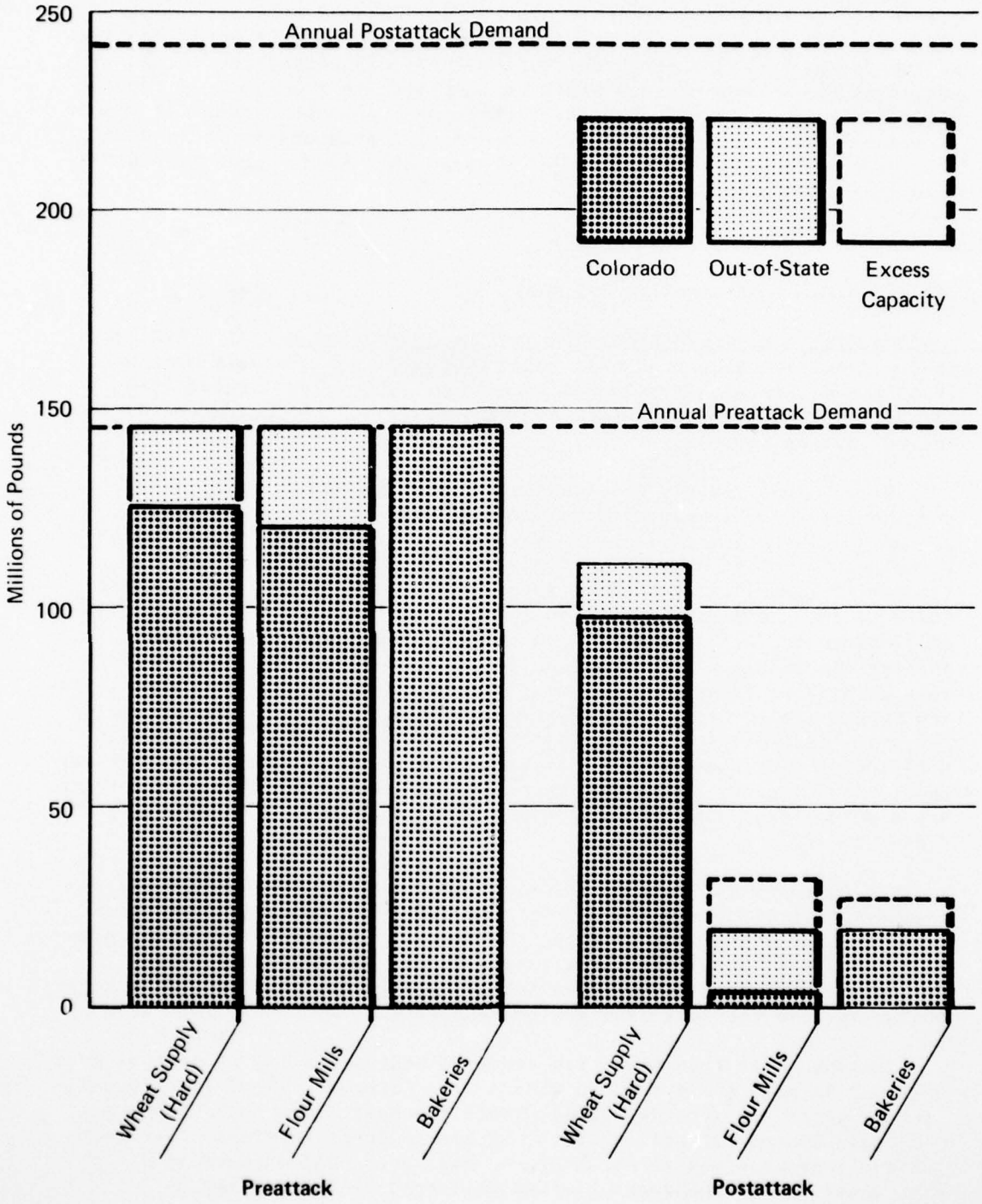
Approximately 78% of the Colorado wheat crop is expected to survive the postulated attack. Exhibit 4.5 shows the survival of the wheat crop, flour mills and bakeries in the distribution chain that supplies bread to Colorado consumers. This figure reveals a critical bottleneck at the flour milling and bakery levels.

Virtually all of the flour milling in Colorado is done by the Peavy Company in Denver. Damage assessment analysis indicates that this facility would be almost completely destroyed. Only production from a few small mills outside the Denver SMSA would be available -- about 2% of normal production.

Only one large and several small bakeries can be expected to survive the postulated attack. These surviving bakeries are capable of supplying approximately 16% of Colorado's postattack consumption needs

EXHIBIT 4.5

SURVIVAL OF WHEAT SUPPLY, FLOUR MILLS AND BAKERIES PROVIDING BREAD FOR COLORADO CONSUMERS



with continuous operation. Even with an increased output, however, the difficulty of obtaining flour from preattack sources makes it highly unlikely that the surviving bakeries will be able to meet more than 10% of the Colorado demand for bread during the first postattack month. Remaining bread requirements would be supplied--to the limit of available flour--by small neighborhood bakeries and consumer ovens. It should be noted that the per-capita emergency requirements set forth in USDA Food Order #2 are approximately 70% greater than those under "normal" preattack conditions.

4.4.4.3 Major Alternative Options.

Raiding Risk Area Grain Stocks During the Relocation Period. Available information indicates that on a national level, considerably more wheat is stored within high-risk areas than is necessary for flour-milling operations. Part of this stock could be moved to the host areas during the relocation period.

On the local level, wheat stored within the Denver SMSA varies considerably, but averages about three million bushels. The Peavy Company -- the primary miller in Colorado -- keeps about 1.5 million bushels on hand and uses about 0.8 million bushels per month in its flour-milling operations. Therefore, from one to two million bushels could be shipped from the risk to the host area during relocation without interfering with flour-million operations. It may be difficult, however, to obtain a sufficient number of hopper railcars to transport this wheat. It is estimated that at any one time, 50 to 100 hopper cars may be available. Assuming 100 are available, about 330,000 bushels or one-sixth to one-third of the total quantity stored within the Denver SMSA could be shipped to the host area. This would be about a 10-15 day supply for Colorado residents, based on NEC standards. Of course, there are already large quantities of grain in Colorado stored outside the high-risk areas.

In Colorado Springs, wheat storage is handled primarily by one company; this firm (Simpson and Co.) has about 20,000 bushels of wheat in bulk on hand immediately after the harvest in July. This level gradually declines, and is almost nil by April of the following year. Nevertheless, depending upon the time of year, this wheat could be shipped by rail to the host area during relocation.

Moving wheat from high-risk areas to host areas is, of course, more critical in some areas than in others. In Colorado, where large quantities of grain are already stored within the host area, such risk-area shipments during relocation would not appear to be critical. For such grain-deficient areas as New England, however, wheat shipped from high-risk areas could supplement limited host-area wheat supplies.

Shipment of Grain to Areas Where Required in the Postattack Period. Haaland (Reference 9) indicates that existing grain stocks--including those on farms and in rural elevators, would be sufficient to supply the

surviving population from six months to one year. However, some areas of the country, such as the northeast, parts of the southeast and parts of California, would require additional grain during the immediate postattack period. Colorado, of course, is a grain-surplus area.

Capacity Expansion. It has been estimated by Sobin and Bull (Reference 37) that the nation's surviving flour mills could increase output by about 75% by increasing annual operating time and restricting output to whole wheat flour.

Capacity Conversion. Feed mills can be used to grind wheat into coarse meal or whole wheat flour, and the output can then be moved to the host area.

4.4.4.4 Summary of Alternative Options.

Under emergency (CRP) or postattack conditions in Colorado, several options for supplying cereals and cereal products are available. It is assumed that milling capacity is limited.

Preattack Options

1. Increase Output of Flour Mills. The output of the Peavy Company flour mill in Denver, which makes virtually all flour produced in Colorado, could be increased approximately 75% by producing only whole-wheat flour and increasing the hours of operation. Additional output could be stored within the host area.

2. Feed Mills Could Grind Wheat Into Meal or Coarse Whole-Wheat Flour and Store in the Host Area During the Relocation or Extended Crisis Period.

3. Move Excess Risk-Area Grain Stocks to Nearby Host Areas During the Relocation Period.

4. Precrisis Transport of Wheat to Wheat-Deficit Areas is a possible but costly option, and also disturbs the orderly flow via normal channels.

Postattack Options

1. Increase Output of Remaining Flour Mills. The Peavy Company, which mills approximately 98% of the flour in Colorado, would not survive the attack. The small surviving Colorado mills could expand output by about 75%. At the national level, an estimated 39% of the flour-milling capacity would be expected to survive the postulated attack, and could also increase output by about 75%.

2. Ship Grain to Areas Where Needed. In Colorado, only local shipments would be required. Earlier studies have concluded that U.S. grain stocks are sufficient to last six months to one year, and that grain can be shipped to such grain-poor areas as New England by surviving transportation facilities.

3. Grind Wheat in Feed Mills, Making Coarse Meal or Whole-Wheat Flour. Wheat could be ground into coarse meal in wheat-growing areas. Such mills are often combined with elevator operations.

4.4.5 Fruits and Vegetables

4.4.5.1 U.S. Situation.

Although survival data specifically for fruits and vegetables does not appear to be available, Brown et al. (Reference 4) indicates that the survival rate for these commodities would not be very different from that of other crops (i.e., about 75%). Based on UNCLEX data, about 63% of the U.S. fruit and vegetable processing capacity is expected to be available 30 days after the postulated attack. Excess capacity of the industry is estimated at 20%.

4.4.5.2 Colorado Situation.

Colorado produces a variety of fruits and vegetables, primarily for local consumption. Overall, the State produces about 25% of its own requirements. In 1975, Colorado's production of fruits and vegetables reached 254.6 million pounds. Most of this production occurs in the summer months. There is little processing of fruits and vegetables, only about 5% of the total. About half of the State's production is exported, mainly during the heavy summer harvest season.

The quantity of fresh fruits and vegetables available to the Colorado population depends upon the time of year of the postulated attack. It is assumed here that the attack occurs during the summer growing season. Under this assumption, approximately 192.9 million tons (76%) of Colorado-grown fruits and vegetables would be available for use during the year.

It is estimated that approximately 46% of Colorado's fruit and vegetable processing capacity would be available after the postulated attack. Postattack demand for fruits and vegetables, based on NEC standards, would be 27% below the preattack demand (see Exhibit 4.6).

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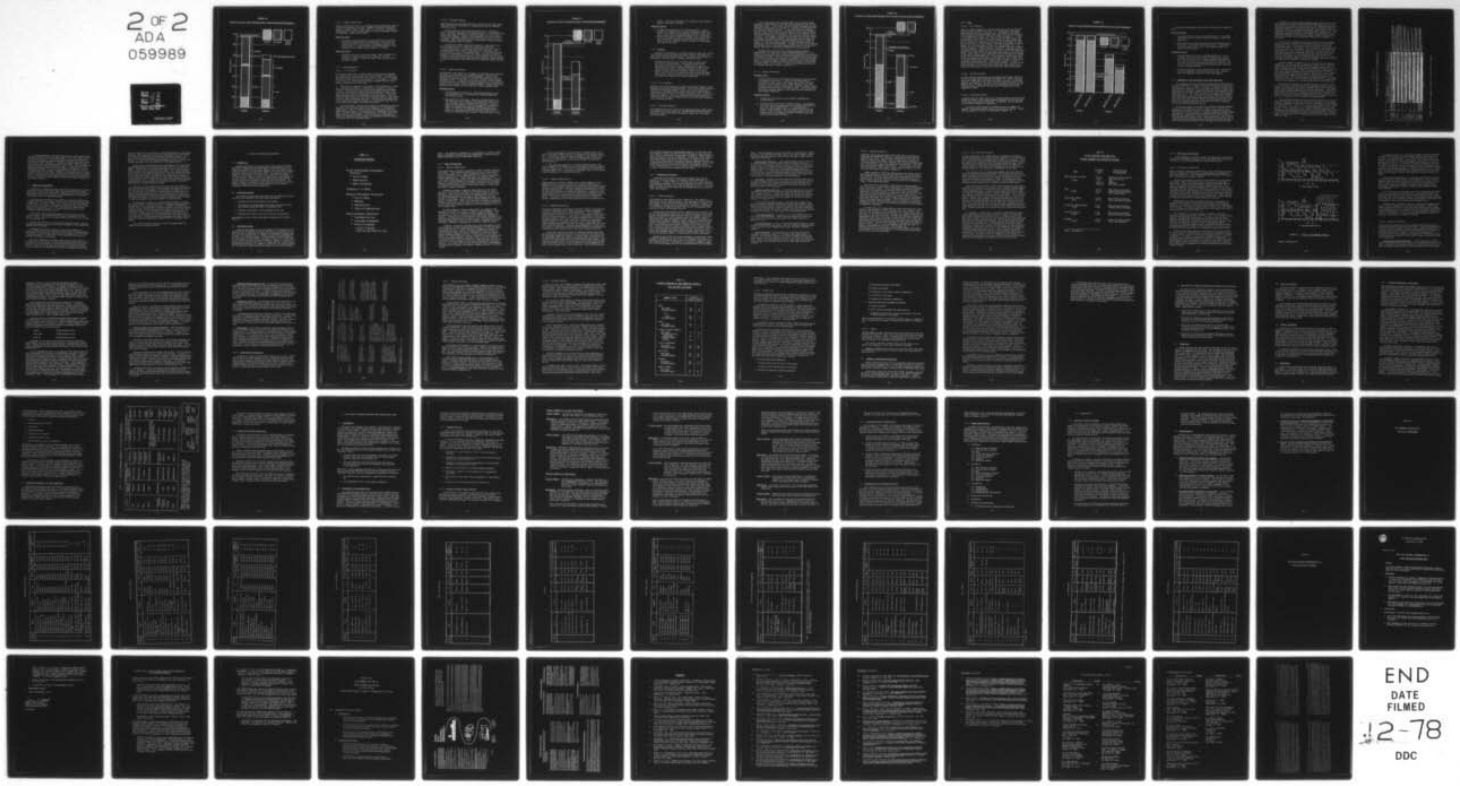

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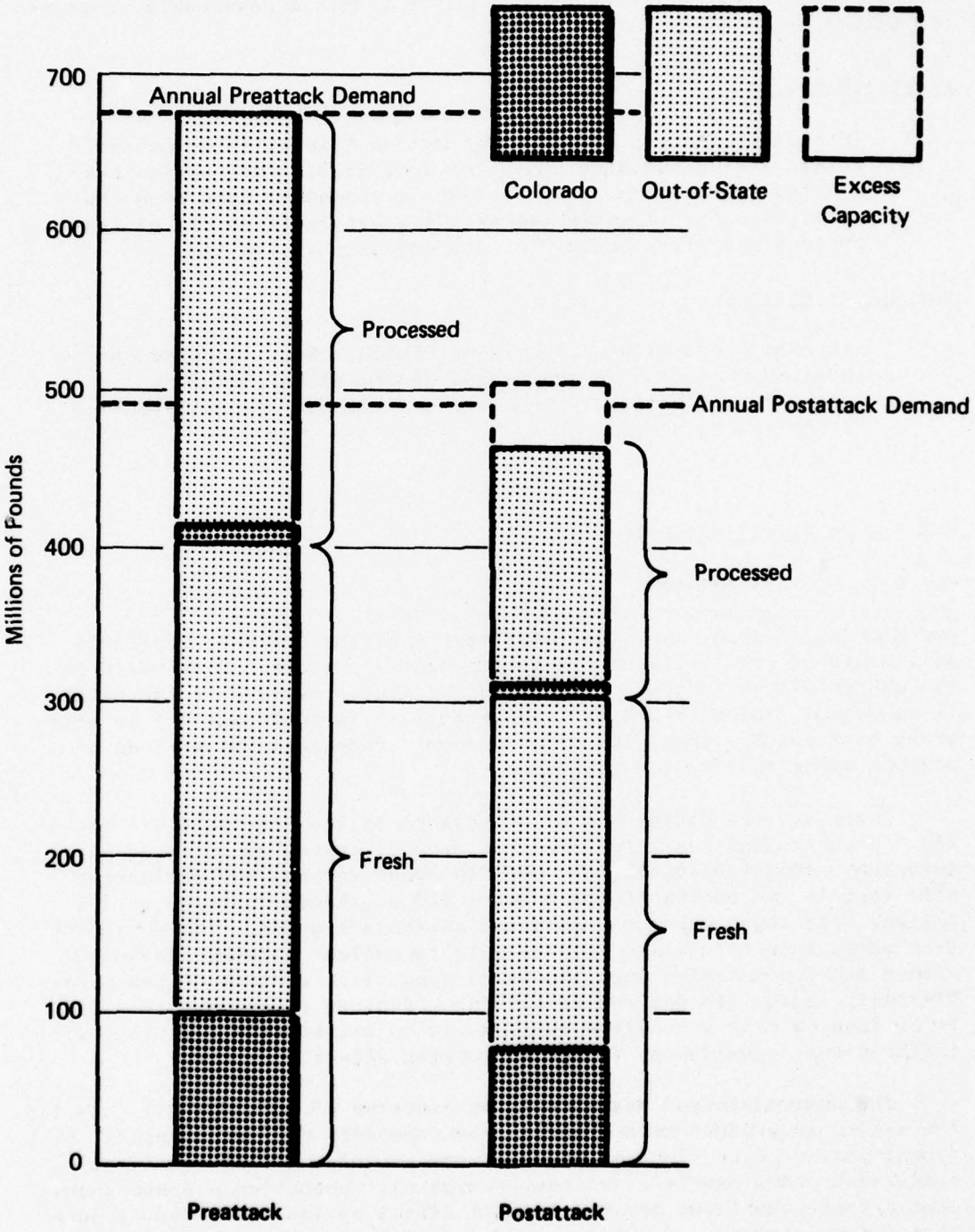
EXHIBIT 4.6

SURVIVAL OF FRUIT AND VEGETABLE SUPPLY SERVING COLORADO CONSUMERS



4.4.5.3 Supply Alternatives.

Effective alternative options for supplementing the postattack supply of fruits and vegetables are limited. Damage to Colorado's processing industry is heavier than to that of the U.S. as a whole. Average U.S. processing survival after 30 days (63%) is within a reasonable range of NEC standards -- about 73% of normal.

Preattack Option

1. Increasing Processed Production During Relocation or Extended Crisis Period and Storing in the Host Area. This option has limited application, since action is dependent upon when the attack occurs; it would decrease the available supply of fresh produce and also industry excess capacity is limited.

Postattack Option

1. Increase Production of Surviving Plants. Some increase can be obtained by extending the period of operation, but this increase is limited. Plants are usually near capacity during harvesting seasons.

4.4.6 Food Fats and Oils

4.4.6.1 U.S. Situation.

The Midwest soybean crop, the chief source of the nation's vegetable oil, could be relatively hard-hit by a nuclear attack. Data based on the UNCLEX attack indicate 100% of the crop will survive if the attack is on June 1, but only 35% will survive if it is on August 1. In most areas of the U.S., these two dates probably represent the periods of maximum vulnerability for this crop.

There are two categories of processors in the vegetable oil industry: crushers and refiners. Neither type of processor is found in Colorado. Crushing plants that produce crude soybean and cottonseed oils tend to be located in the Midwest and Southeast portions of the nation, near areas where soybeans and cotton are grown. Their dispersion makes them relatively invulnerable to nuclear attack. Refining plants are concentrated near the large population centers of New Jersey, Illinois, Texas, Georgia and California. Because refining plants tend to be located near population centers, it is anticipated that they will suffer significant damage in the postulated attack.

The United States' position as an exporter of fats and oils has led the nation to produce more than its own vegetable oil requirements in recent years. Even if no edible oils are exported during the first postattack year, however, refinery damage will undoubtedly cause shortages. These shortages may be slightly offset by increased use of such animal fats as lard and butter. The food fats and oils processing industry is expected to retain 49% of its preattack productive capability 30 days after the postulated attack.

4.4.6.2 Colorado Situation.

Host area survivors may expected to have a three- and four-week supply edible fats and oils available for consumption during the immediate postattack period.

Colorado does not raise significant quantities of soybeans or cotton, and has no vegetable oil processing plants. It is expected that none of the animal fats and oils processing plants will survive the attack without damage. However, local postattack supplies of fats and oils may be augmented somewhat by animal fats produced by local meat processors. Butter supplies might be supplemented by converting otherwise unprocessable cream into butter.

Colorado's postattack productive capability is estimated at two million pounds per year, or about 3% of preattack production. If the excess capacity of remaining plants were used, this could be increased to about 5%. Out-of-state supplies are estimated at 66 million pounds, or 62% of the preattack level. U.S. and Colorado food fats and oils consumption is about 56 pounds per capita, but the NEC standard is about 26 pounds per capita. Thus, assuming Colorado retains its share of surviving out-of-state production capacity, there should be no long-term shortage of food fats and oils following an attack (Exhibit 4.7).

4.4.6.3 Supply Alternatives.

The relatively large quantity of inventory of food fats and oils held by wholesalers, retail stores, and consumers presents a less critical supply situation than for most other commodities, since more time is available for the national supply lines to be reestablished during the postattack period. In addition, since food fats and oils NEC standards are only about half of "normal" preattack standards surviving productive capability will probably satisfy postattack demand. Several options for supplementing the supply of food fats and oils are discussed below.

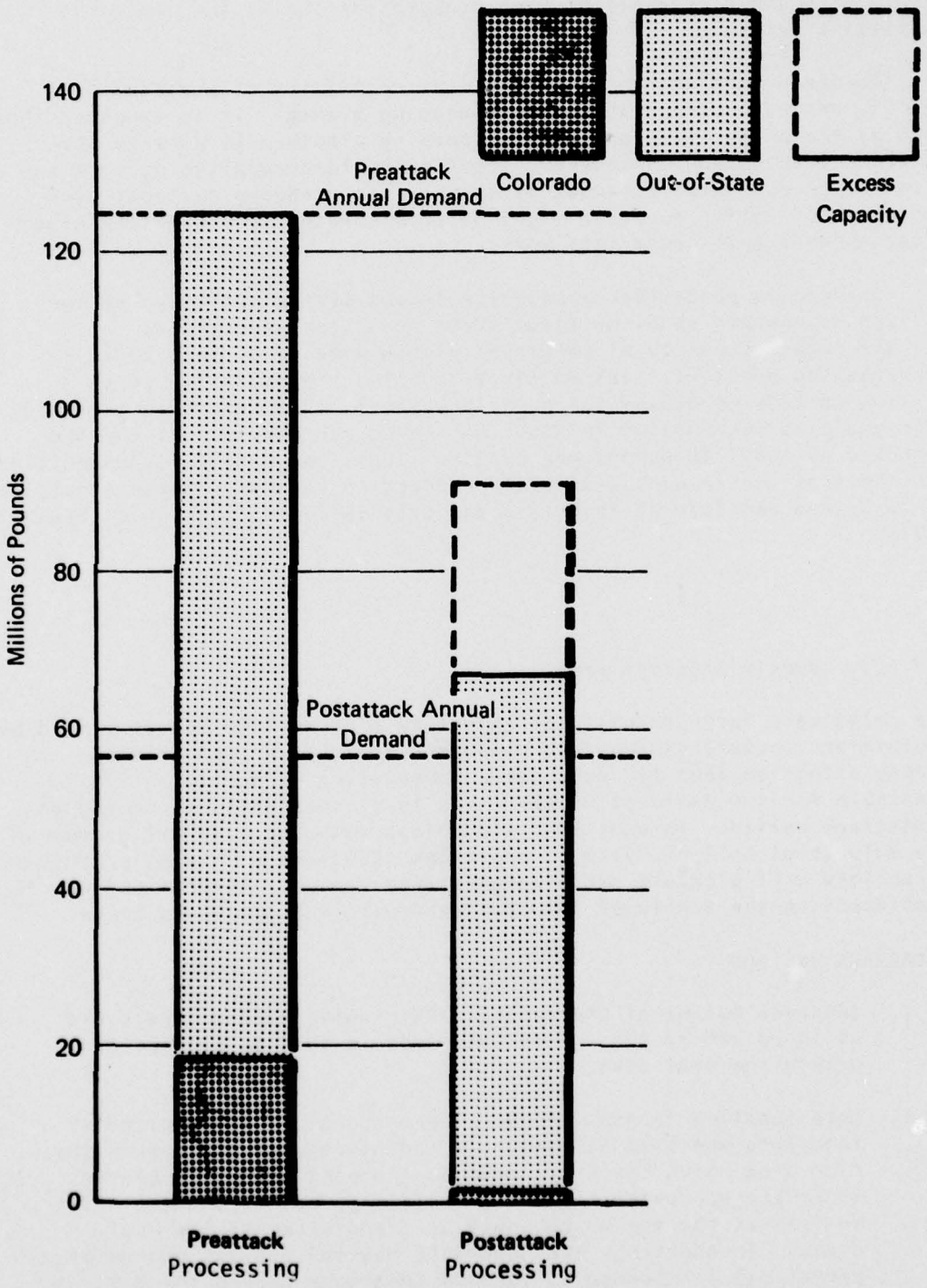
<u>Preattack Options</u>

1. Increase Output of Shortening. Shortening manufacture could be increased by 87%. This output could then be stockpiled within the host area.

2. Move Supplies to Host Areas. There are sizeable supplies of food fats and oils at factories and storage facilities in the risk area which could be moved to the host area. In Denver, there are approximately three million pounds of shortening in commercial storage which could be transferred to the host areas. In addition, the USDA/ASCS has 160,000,000 pounds of peanut oil in storage at various locations around the U.S. A listing of these facilities is shown in the Guidelines to this

EXHIBIT 4.7

SURVIVAL OF FOOD FATS AND OILS SUPPLY FOR COLORADO CONSUMERS



report. The primary locations are in Georgia, North Carolina, Alabama, Louisiana, and Texas.

Postattack Option

1. Increase Processing Output of Food Fats and Oils. Overall production of vegetable oil could be increased by about one-third. The industry already operates 24 hours per day, seven days per week, but at two-thirds capacity only. Surviving animal fat production plants in Colorado could increase production of shortening by 87%; the average for the nation is about one-third. Weighted possible increase or excess capacity would be about 33%.

4.4.7 Potatoes

Because of its hardiness, its unique nutritive value, and its ability to substitute for both meat and cereal products, the potato is a particularly valuable postattack crop. The utility of the potato in wartime is a fact of history. Reference 25 reports that:

> Potatoes are among the most reliable foods to insure man's survival during modern wars. This has been amply proved during the last two world wars. Potatoes are not easily destroyed by fire even in storage because they contain enough water to prevent them from burning. Potatoes in the field cannot be readily burned in contrast to grain crops such as wheat. This was well illustrated after the fighting had swept over Okinawa. The people could dig potatoes and survive after most other food supplies were eaten or destroyed.

4.4.7.1 U.S. Situation.

Harvest of the large national fall potato crop normally begins in mid-September and continues through October. This harvest commonly supplies the nation with enough potatoes to last until the following summer. Data based on the UNCLEX Charlie attack indicate that 45% of the U.S. potato crop would survive if the attack occurred on June 1 and 82% if it occurred on August 1. The surviving potato-processing capability is estimated to be the same as frozen fruits, fruit juices and vegetables (i.e., 73% after 30 days).

4.4.7.2 Colorado Situation.

The probable survival of so much of the national harvest, coupled with the availability of the local crop, indicates that Colorado survivors would have a sufficient supply of potatoes, except for a few weeks during the summer.

The Colorado potato crop represents about 3% of national annual production. Approximately 91% of this crop is expected to survive the postulated attack. If the attack occurred between mid-August and June, potatoes in storage could be available to residents of Colorado during the immediate postattack period. If the attack occurred in August, however, there would probably be a shortage of locally-grown potatoes. National stocks of the previous year's large fall crop (usually 75% of the nation's production) are exhausted, but during the ten-week period from June 1 to mid-August, Colorado receives about five million pounds of potatoes from outside the State. Harvesting of the Colorado crop would begin in August, and out-of-state shipments would no longer be needed. In 1975, an average of about ten days inventory was held by wholesalers, retailers and consumers. In addition, most of the Colorado Springs host area is within easy transportation reach of the San Luis Valley, where most of Colorado's potatoes are grown and stored.

Colorado has a relatively small potato-processing industry, accounting for only about 24% of total processed consumption. It is expected that only about 10% of this processing capability would survive the postulated attack. Most of Colorado's processed potato requirements are shipped to Colorado in frozen form from Idaho, California and other states. Per-capita postattack demand is about 83% of preattack demand and total postattack demand is about 225 million pounds, or 82% of the preattack demand. The survival of fresh and processed potato supplies for Colorado residents is shown in Exhibit 4.8.

4.4.7.3 Supply Alternatives.

Preattack Option

Increase Production of Dried Potato Products During the Relocation or Extended Crisis Period. In 1975, dried potato products accounted for 27% of total potato usage, but industry officials indicate that the industry has an excess capacity of only 10% (assuming fresh potatoes are available), since the industry usually operates 24 hours per day, seven days per week. Thus, dried potato-processing excess capacity is only about 3% when compared with total potato consumption.

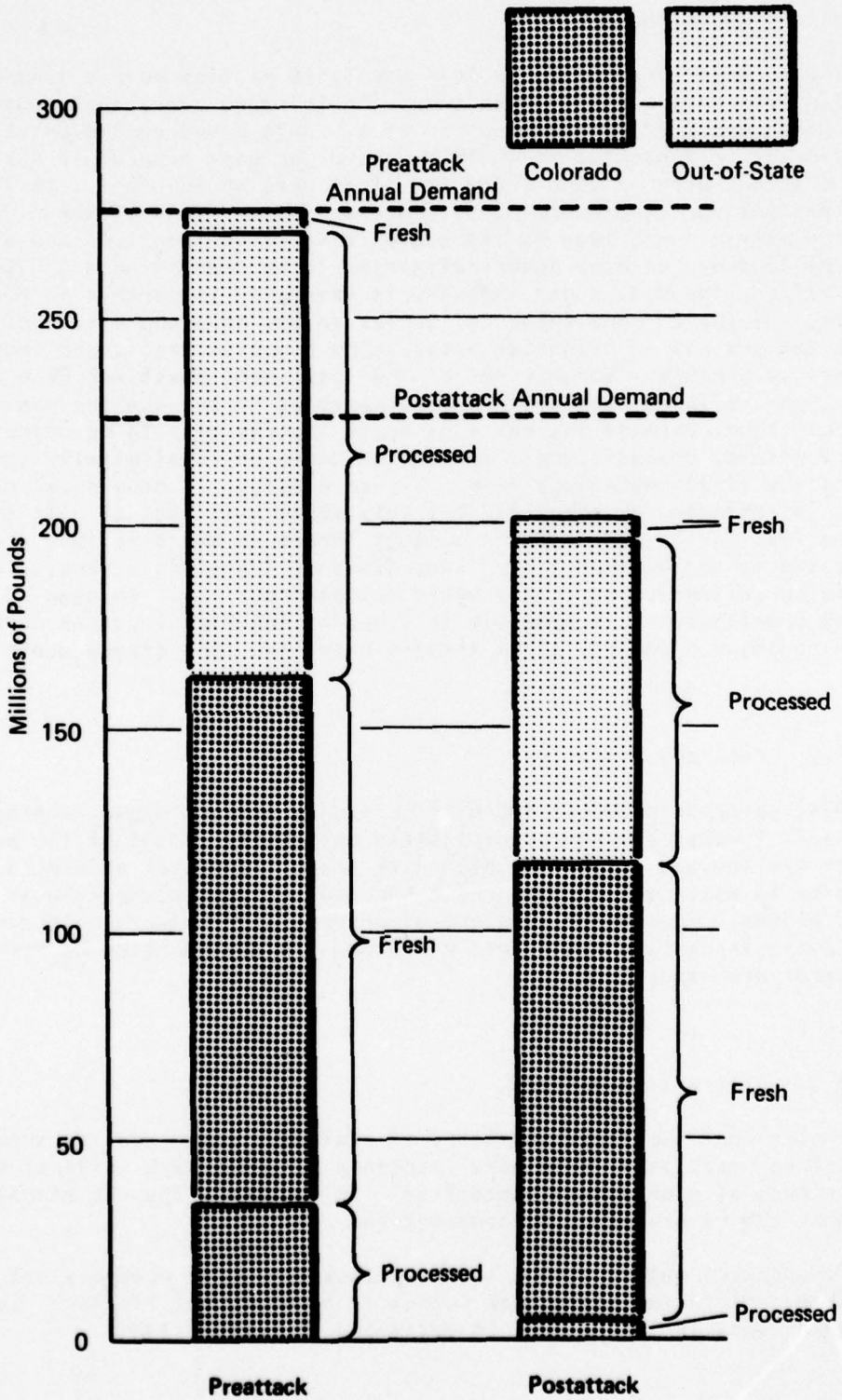
Postattack Options

1. Increase the distribution of raw potatoes, bypassing the processing step.

2. Increase Output of Surviving Processing Plants. Approximately 73% of the potato-processing capacity is expected to remain 30 days after the postulated attack. As indicated above, however, excess capacity within the industry (both dried and frozen) is quite limited. The processing industry, with its present plant, could possibly increase its output up to 10%, assuming potatoes were available.

EXHIBIT 4.8

SURVIVAL OF FRESH AND PROCESSED POTATO SUPPLIES FOR COLORADO CONSUMERS



4.4.8 Sugar

4.4.8.1 U.S. Situation.

Total U.S. sugar production in 1974 was 5.519 million metric tons and total stocks were 2.646 million tons. In the same year, beet sugar production was 2.727 million metric tons. Data based on the UNCLEX-Charlie attack indicates that 45% of the sugar beet crop would survive if the attack were on June 1 and 82% if it were on August 1. In 1974, cane production (Continental U.S., Puerto Rico and Hawaii) was 2.792 million metric tons. Due to its heavy reliance on imported cane sugar and the tendency of cane sugar refineries to be concentrated in large port cities, the U.S. sugar industry is extremely vulnerable to nuclear attack. Of the 24 cane sugar refineries in the mainland U.S., only about 25% are not in high-risk areas. The domestic beet sugar industry is less vulnerable. Roughly 49% of the total U.S. preattack cane and beet sugar refining capability may be expected to survive the postulated attack. Thus, even if the raw cane sugar imports were to be unimpaired by the attack, domestic sugar production would be substantially reduced during the first postattack year. Excess capacity in cane sugar refineries is estimated at about 25% but only about half that at beet sugar refineries, partly due to sugar content losses in beets if they are not processed at the optimum time. Long-distance transport of beets to surviving refineries generally would not be practical. In case of unexpected shortages, it is possible that additional high-fructose corn syrup could be produced, since these plants have some excess capacity.

4.4.8.2 Colorado Situation

In 1974, Colorado produced 800 million pounds of beet sugar, making it the fifth-largest sugar-producing state nationally. Most of the sugar plants are located out of the high-risk areas. Survival of processing capacity is estimated at 73%, while survival of beet production is estimated at 66%. The sugar inventory at processing plants in Colorado is relatively large, and could last more than six months assuming NEC standards are used.

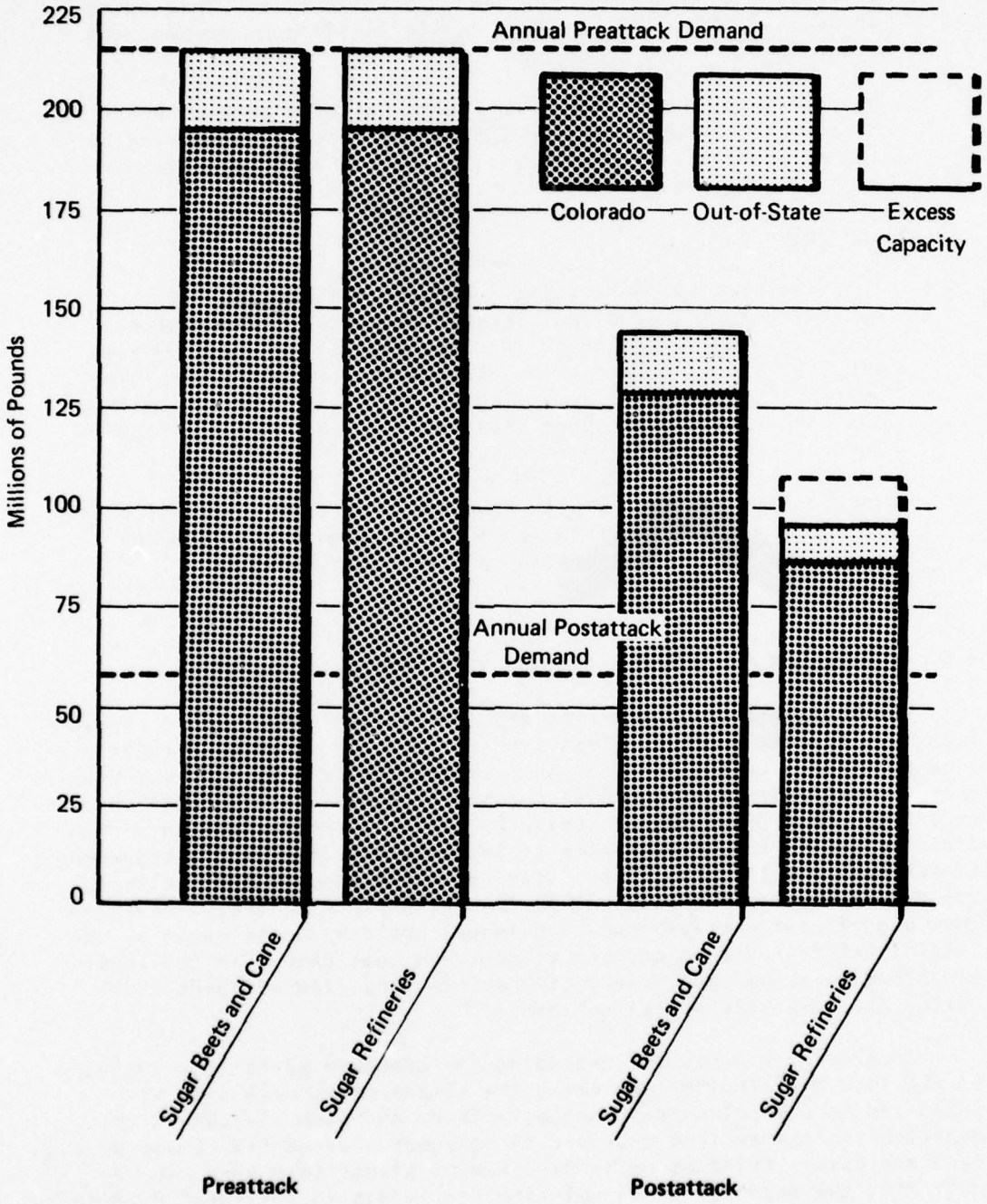
4.4.8.3 Alternative Options.

It appears that the large inventory of available sugar and the surviving productive capability would make emergency measures less critical than in the case of some other commodities. In addition, the NEC standards are only 27% of present U.S. consumption.

Increasing output during the preattack period is probably not possible; increasing postattack output is possible but limited. Excess refinery capacity in the U.S. is estimated at roughly 14%.

EXHIBIT 4.9

SURVIVAL OF SUGAR SUPPLIES AND REFINERIES FOR COLORADO CONSUMERS



Preattack and postattack sugar supply alternatives are summarized below:

Preattack Options

1. Increase the Output of Beet and Cane Refineries. This option is possible but very limited, due to limitations on beet and sugar input.

2. Move Inventories of Sugar Processors Out of High-Risk Areas to Host Areas. Processor inventories are large -- amounting to several months of normal usage -- and could be moved from high-risk to host areas.

Postattack Options

1. Increase Production of Surviving Sugar Refineries. It is estimated that (excluding possible transportation problems) surviving refineries could increase production approximately 14%. Such an increase would require that raw sugar arriving by sea be diverted to surviving mainland cane refineries, and that (in some cases) sugar beets be shipped greater distances to surviving beet refineries.

2. Increase Production of High Fructose Corn Syrup. Plants producing this sweetener (now about 0.8 million short tons per year) are presently operating at less than capacity.

4.5 COMPARISON OF COLORADO SPRINGS WITH OTHER RISK AREAS

Early research into the problems of feeding the surviving population in a postattack environment studied the nationwide availability of food supplies. Later, in 1965, in an effort to resolve the many unanswered questions regarding local postattack distribution, research was undertaken on a detailed, commodity-by-commodity investigation of food distribution in the three cities of Detroit, San Jose, and Albuquerque (References 10, 11, 12). These studies, which assumed that citizens would seek shelter in-place rather than evacuate risk areas, revealed that significant supply/demand imbalances could be anticipated at the local level following a nuclear attack, and that damage to the local distribution system could severely restrict the flow of foodstuffs during the immediate postattack period.

To provide a basis for assessing the probable postattack adequacy of the food distribution system in the sample city, each city was subjected to a hypothetical nuclear attack, and each element of the distribution system from producer to consumer underwent a damage assessment analysis. Existing nationwide damage assessments were used to determine the degradation of out-of-state inputs to the local distribution systems under imposed attack. Whenever possible, point-by-point assessments were developed and used to estimate the damage suffered by critical distribution elements within the sample metropolitan areas.

The results of these damage assessments were applied to the preattack commodity-flow models to predict the probable postattack flow of the selected food groups to local survivors. The surviving distribution system was examined for bottlenecks that might be caused by losses in production capability, processing capability, labor productivity, supply availability, warehousing space, and transportation accessibility. The postattack inventories derived in this manner were compared with the USDA's NEC standards to determine the degree to which supplies of the selected commodities could be expected to meet the requirements of survivors.

The survivors' consumption levels for the three cities discussed above, of course, reflected in-place rather than crisis relocation consumption levels. The survival rate in the Detroit project was approximately equal to the national level of survival under crisis relocation planning (i.e., about 90%). For both San Jose and Albuquerque, the population survival rates were about 78%. To provide a basis for comparison under crisis relocation conditions, survival rates in San Jose and Albuquerque were increased to reflect the national CRP survival rates (90%). That is, postattack consumption levels in each city were increased by about 15%, and the depletion rates for surviving food supplies were adjusted to reflect this change.

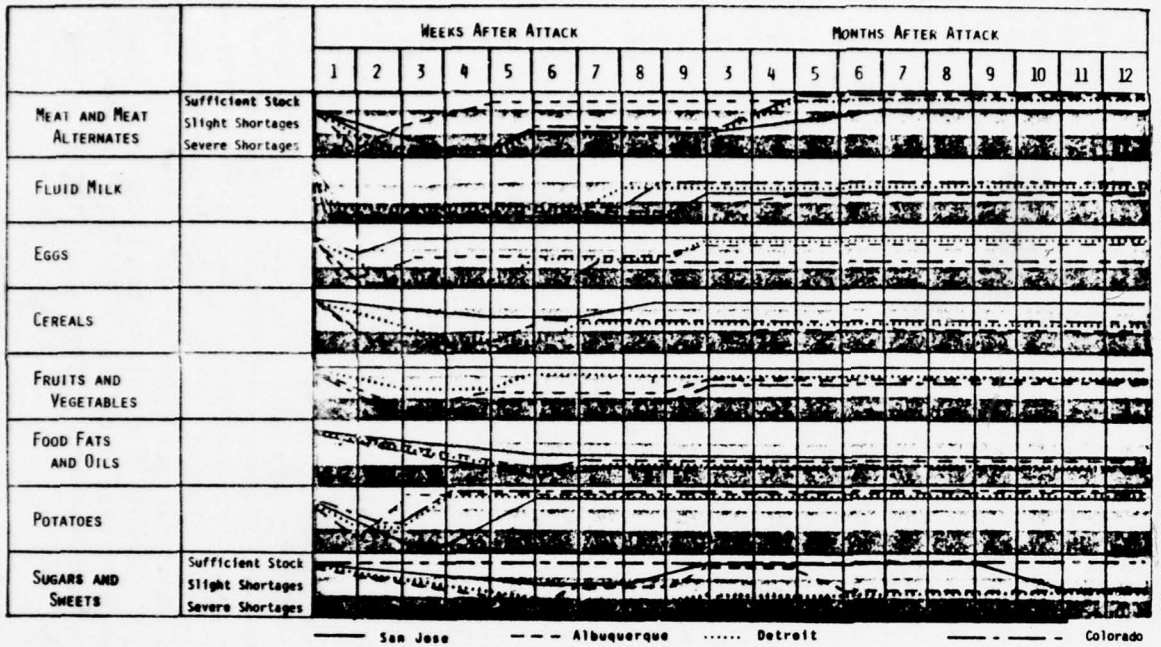
A graphic summary of results for the cities of San Jose, Detroit, Albuquerque, and Colorado Springs appears in Exhibit 4.10. Under the assumed attack conditions, survivors in Albuquerque would experience severe shortages of every commodity except potatoes at some time during the first postattack month. Detroit survivors fared little better, experiencing severe shortages of every commodity except fruits, vegetables and potatoes during the same period. San Jose survivors could expect severe shortages of meat, milk and potatoes during the first postattack month. The single commodity in shortest supply in all three cities was fluid milk. It is unlikely that preattack milk consumption levels would be attained at any time during the first postattack year.

The results in Exhibit 4.10 indicate that surviving food inventories in both Detroit and Albuquerque would disappear rapidly after an attack, leaving these cities heavily dependent upon out-of-state suppliers and long-distance transportation for many commodities. Unless emergency supply and distribution capabilities beyond those currently available in these two cities are developed, local survivors would find it extremely difficult to obtain an adequate nutritional balance during the three- to six-week period following the postulated attack.

In the Colorado Springs host and risk areas, meat will be in short supply for about one and one-half weeks, until radiation is low enough to permit resumption of production in some of the packing plants damaged by blast and/or fire. Milk will be in very short supply initially, and the industry will not recover full processing capability for at least one year. Also, shortages of eggs, cereal, fruits and vegetables can be expected during the second week after the postulated attack. Supplies of food fats and oils should last until outside sources can be reestablished. Existing supplies of potatoes and sugar should be ample to last almost one year.

EXHIBIT 4.10

POSTATTACK FOOD AVAILABILITY IN FOUR SAMPLE CITIES



Early shortages may be alleviated by the immediate slaughter of livestock receiving lethal radiation doses. Output from expedient slaughter facilities would supplement imports until permanent facilities can be rebuilt.

Preattack stockpiling of canned and dried milk products would help to alleviate postattack shortages. Insofar as possible, milk produced shortly after the attack should be processed into cheese & butter to reduce the radiation hazard.

Because eggs need no processing and can be marketed directly by the poultry farmer, the period of severe shortage after the attack will be limited.

Severe shortages of bakery products may be alleviated by increased production from surviving neighborhood bakeries and consumer ovens. It is expected that milling of whole-wheat flour will increase.

Early postattack shortages should disappear as soon as national transportation and communication links are completely reestablished.

Vegetable oil shortages may be offset by heavier use of such animal products as lard and butter.

The combination of potatoes held in growing area storage facilities and the local and nearby summer and fall potato crops should quickly alleviate any postattack shortages.

National sugarbeet production quotas should be adjusted as soon as possible after the attack to compensate for acreage losses and heavy damage to the nation's sugar cane refineries.

(Source: Reference 5, updated by SYSTAN to include Colorado findings)

For some commodities, the supply patterns for the Colorado Springs data and the other three cities are similar. This is the case for milk and food fats and oils. On the other hand, the Colorado Springs area supplies of potatoes and sugar are relatively greater than those of any of the other cities considered. Colorado is a major potato and sugar beet growing state, and has substantial quantities of these potatoes and sugar in storage throughout most of the year. Cereals are a critical commodity group which will be in short supply in Albuquerque, Detroit and Colorado Springs. Flour mills and bakeries are hard-hit, not only in these cities but nationwide. However, in some areas such as Colorado Springs, sufficient grain stocks are available and can be used in other forms. In addition, surviving grain stocks in the Detroit area would be sufficient to meet survivors' needs for cereals and cereal products for more than two months.

4.6 SUMMARY AND CONCLUSIONS

The number of persons surviving under CRP as compared with in-place protection is much greater and, hence, food requirements are greater. Under CRP, with 5% of the labor force considered to be critical workers, approximately 99% of the population in Colorado Springs risk and host areas would survive the postulated attack.

The crop and livestock survival patterns of the United States and Colorado appeared to be somewhat similar, where available data permitted a comparison. For crops, however, the survival rate very much depends on the time of the attack. The damage is generally light if the attack occurs at any time other than in the early growth and reproductive stages, and moderate to heavy if it occurs when the crop is in its vulnerable stage (around early June).

The Colorado food processing industry is fairly heavily concentrated in Denver, and generally was more heavily damaged than is the U.S. as a whole. The overall average survival rate for the U.S. is 45% and for Colorado 39%.

At some time during the first month following the attack, Colorado Springs host-area survivors may anticipate shortages of most commodities except potatoes and sugar.

Although most major meat packers will be heavily damaged, the remaining plants will have considerable excess capacity if some processing steps are eliminated and, within four to six weeks after the attack, these plants could fill about 62% of the Colorado Springs host-area emergency consumption requirements.

The single commodity in shortest supply following the attack will be fluid milk. Heavy damage to local milk processors would cause severe shortages of milk to persist for several months following the attack. However, since most of the dairy herd would still continue to be productive, production of evaporated milk could be increased and fresh milk

could be shipped out of the state for drying and returned for use within Colorado. Also, since most of the dairy herd would survive the attack, milk could be purchased directly from host area dairy farmers. Even taking into account these and other alternative courses of action, however, it is unlikely that preattack consumption levels of fluid milk would be attained at any time during the first postattack year.

Heavy damage to Colorado flour mills and bakeries will cause shortages of baked products to persist during the first year following the attack. Overall U.S. milling and baking capacity will also be hard-hit, but will survive better than that of Colorado. Local flour shortages could be partly alleviated by shipments of flour from outside the state. Other alternatives include increasing flour production during the relocation period and moving it to the host area, expanding the output of surviving millers, and grinding wheat in feed mills, making coarse meal or whole-wheat flour. In addition, the cereal shortage in the immediate postattack period can be offset by releasing a portion of Colorado's grain reserves to mass-feeding facilities.

Generally, Colorado storage facilities for such raw products as wheat and potatoes are primarily located outside the major risk area and will survive with little damage. Major wholesale distribution facilities, on the other hand, which are located mainly in Denver were very heavily damaged by blast and fire. Only an estimated five percent of Colorado's food wholesale distribution warehouse capacity would survive the postulated attack. The surviving capacity would be primarily that of smaller wholesalers and of City Markets in Grand Junction.

The throughput of these surviving wholesalers might be increased 50% within ten days following the attack. Warehouse space equivalent to an additional 12% of preattack capacity is available in buildings in Larimer County. The remaining distribution capacity required to support the flow of food to Colorado Springs survivors will have to come from commandeered space or the construction of emergency warehouses. At least four to eight weeks will be required before local distribution facilities can be expanded and constructed to meet the needs of survivors effectively. During this period, substantial supplies of food will have to be channeled through mass feeding centers or emergency supply depots.

The various alternative courses of action discussed above are summarized in the following section.

5. REVIEW OF POSTATTACK ALTERNATIVES

5.1 INTRODUCTION

Whereas distribution of food to citizens displaced by preattack population movements may be accomplished by local adjustments in the distribution system, the continued feeding of survivors following an attack may require that significant changes in the distribution system be made at both local and national levels. The necessary degree of change will be dictated, of course, by the severity of the attack. It is clear, however, that the survival of many citizens could depend on the flexibility of both the local food distribution system and the national channels of distribution supplying the local systems. This chapter contains an assessment of the feasibility and effectiveness of potential changes in local and national patterns of food supply, processing, distribution and transportation.

5.2 EVALUATION CRITERIA

Four general criteria have been identified for comparing the relative merits of postattack food distribution strategies:

1. Preattack set-up and maintenance requirements;
2. Vulnerability to attack damage (hence the likelihood of preattack measures being available for postattack use);
3. Operating requirements in the postattack period; and
4. Postattack performance in serving the surviving population.

More detailed criteria within these general categories are listed in Table 5.1.

5.3 POSTATTACK OPTIONS

During the postattack period, the resumption of transportation and communications is necessary to support the flow of food supplies, and this flow will be redirected in response to estimates and requests from the state food organizations in a manner that alleviates shortages and provides for a continuing supply of food throughout the United States. In the framework of CRP, however, the number of surviving citizens would be much greater than under in-place protection planning. Citizens will out-survive distribution facilities in a manner that will create severe supply/demand imbalances in a number of localities, and careful planning will be required to match supply with demand in the critical emergency

TABLE 5.1

EVALUATION CRITERIA

Set-Up and Maintenance Requirements (Preattack)

- Facility Needs
- Administration
- Annual Maintenance

Vulnerability to Damage

Operating Requirements (Postattack)

- Facility Needs
- Manpower
- Administration
- Stress on Transportation

System Performance (Postattack)

- Implementation Time
- Likelihood of Breakdown
- Effects on Consumer
  - effort to prepare
  - nutrition and variety of diet

period. The remainder of subsection 5.3 is devoted to a review of those supply, processing, distribution, and transportation alternatives that might be employed to rectify postattack imbalances.

5.3.1 Supply Alternatives

5.3.1.1 Supplier Substitution.

The simplest supply alternative available in time of stress is supplier substitution. This alternative might take the form of brand substitution at the consumer level, vendor substitution at the retail level, producer substitution at the wholesale level, or supplier substitution at the processing level. History has shown that consumers exhibit little brand loyalty when faced with potential food shortages. Furthermore, none of the wholesalers or processors interviewed envisioned any problem in changing their sources of supply following a nuclear attack in response to a directive from an Order Administrator, provided that some sources remained undamaged.

Although the concept of supplier substitution may seem simple, there are a few practical limitations to its application in time of emergency. Under normal conditions, the average elapsed time between the placement and receipt of an order by wholesalers is ten days. In the case of processors, the time between order placement and order arrival is even greater, particularly for those dependent on rail shipments of raw materials. Hence, any distributor or processor attempting to change its normal source of supply following an attack can expect to wait at least ten days before shipments from the new source will arrive at the loading dock.

The effectiveness of supplier substitution will depend on the nationwide vulnerability of specific types of food processors and on the ability of surviving processors to meet postattack demands. The vulnerability of the U.S. food distribution system was discussed in Chapter 4. Reference 27 and the reports of the National Commission on Food Marketing (References 28 through 32) give a detailed picture of the geographic dispersion of the U.S. food industry, and References 33 and 34 contain vulnerability assessments for specific commodity groups.

In general, the overall vulnerability of the food industry is low. Food production is widely dispersed geographically, and the free enterprise system has built a certain degree of redundancy into most food processing activities. Specific processing capabilities that are usually cited as being particularly vulnerable to attack include the yeast-processing industry, with only 14 major plants in the United States; the citrus processing industry, centered in Florida and California; the cane sugar industry, with most of its refineries located in vulnerable port cities; the processors of edible fats and oils; and the eastern U.S. milling industry, with a heavy concentration in Buffalo, New York. The overall survival rate for flour milling is 39% (based on the UNCLEX-Charlie attack), while bakery industry survival is from 20% to 25%.

Fluid milk processing is a particularly vulnerable part of Colorado's food supply system, with only 11 percent of its capacity surviving. Flour milling, with less than ten percent of the capacity surviving, is in the same category. Other vulnerable points in the supply system roughly coincide with the points of national vulnerability mentioned earlier.

If the postattack demand for a commodity exceeds the surviving supply capability, the effectiveness of a strategy of supplier substitution will depend on the ability of surviving suppliers to expand their preattack capabilities. This ability is discussed later in this chapter under the heading of Processing Alternatives.

5.3.1.2 Commodity Substitution.

Substitution of a plentiful commodity for a scarce commodity in the postattack period is another simple form of supplier substitution. Table 5.2 lists acceptable substitution rates among the commodity groups identified in the National Emergency Consumption Standards specified by the USDA (Reference 35). This table emphasizes the versatility of cereals and cereal products as a substitute commodity-- a versatility that might be exploited in the likely event that the grain storage facilities of the Denver and Colorado Springs host areas survive the postulated attack. In addition, risk-area grain stocks which are in excess of millers' needs can be moved to host areas during the relocation period.

5.3.1.3 USDA/ASCS Stockpiles.

At present, USDA/ASCS food stockpiles are quite limited in the type and quantity of commodities held. Some dried milk is held in USDA/ASCS stockpiles (about 385 million pounds nationwide). This is enough to feed survivors for about five to six days, if this source of milk supply were relied upon exclusively. About one million pounds of dried milk are held in Denver. Peanut oil is another commodity which is held under USDA/ASCS authorization. About 160 million pounds is on hand nationwide; no peanut oil is stored in Colorado. All of these USDA/ASCS stockpiles should be moved from high-risk areas to host areas during the crisis relocation period. The guidelines accompanying this report aid the planner in identifying and locating those stockpiles which should be transferred to host areas as part of the crisis relocation program.

In the past, food for survivors of localized disasters has often been obtained from government stockpiles maintained by the USDA as part of its Donated Commodities Program. In recent years, the availability of USDA-donated foods from state warehouses has been on the decline due to the switch from donated foods to food stamps for needy people. This trend has reversed in the very recent past, to the extent that the USDA Food and Nutrition Service is now purchasing more food commodities for school lunch programs than in previous periods. The Food Stamp and the

School Lunch programs are on-going USDA projects. In 1977, there were two instances in which the USDA/Food Nutrition Service authorized the use of School Lunch Program food in natural disasters. Replenishment of stocks was then carried out by USDA/ASCS. It should be noted, however, that food donated to the School Lunch Program is owned by state and local school lunch agencies, and may be moved as these agencies see fit. It appears that this type of assistance could be expanded. School Lunch Program food should be removed from the high-risk areas during the crisis relocation period. A list of School Lunch Program food on hand is shown in the guidelines accompanying this report.

5.3.2 Processing Alternatives

Preattack food-processing patterns and capabilities might be altered in a variety of ways in an attempt to meet postattack food requirements. In some industries, the capacity of surviving processing plants might be expanded. The plants and equipment of certain non-food industries might be converted to food-processing facilities. In extreme cases, ordinary processing steps might be bypassed entirely by distributing raw foodstuffs.

5.3.2.1 Capacity Expansion.

The concept of plant capacity is not a simple one. The output of a single plant may vary with employment, with the number of shifts worked, with changes in the production process, with the item-mix produced, and with changes in quality control tolerances or procedures. Discussions of the concept of production capacity and its role in postattack planning may be found in References 36 and 37.

In describing the preattack flow of foodstuffs into the Denver and Colorado Springs metropolitan areas, the annual production rates of the various food-processing industries were implicitly assumed to represent measures of capacity. Under emergency conditions, however, many of these industries could be expected to employ a variety of strategies to increase their preattack production rates. Among the simplest and most effective strategies for increasing emergency production are the addition of extra working shifts and the introduction of a seven-day work week. Ratios of potential emergency operating levels to normal levels of shift operation have been developed by the National Planning Association of the Department of Commerce (Reference 38). Additional production rate increases might be achieved by standardizing output, simplifying the production process, or relaxing quality control tolerances.

Because of the ability of certain processors to expand their output in times of emergency, the proper basis for assessing the adequacy of postattack food-processing facilities is not preattack output but potential emergency capacity. Assessments of the potential emergency capacity of the food processors serving the Colorado metropolitan area appear

below. These assessments reflect the opinions of Colorado food industry personnel, data obtained from major firms in the field, industry associations and trade publications, USDA reports, and past research reports (References 37 and 38).

Meat and Meat Alternates. Local packing plants typically work one to two shifts daily, timing the end of the most productive shift to coincide with the opening of retail outlets. The chief limitation on a plant's ability to increase its rate of slaughter in time of emergency appears to be the availability of refrigerated storage space for prepared meats. If livestock were available and storage problems were solved (either by providing additional space or distributing freshly-killed meat more rapidly) surviving Colorado packers could double their normal output to help meet postattack food requirements.

Fluid Milk. Assuming sufficient supplies of raw milk were available under emergency conditions, local dairy officials estimate that the average daily gallonage produced by Colorado dairies could be nearly doubled by working three shifts instead of two and by increasing the work week from five to seven days.

Cereals and Cereal Products. In a detailed analysis of flour-milling capacity, Sobin and Bull (Reference 37) conclude that the nation's flour industry could "....expand flour output by about three-fourths over capacity as ordinarily measured, through (a) increasing operating time per year and (b) restricting the output of flour mills to whole wheat flour" (Reference 37).

Colorado bakeries would be able to increase their production as much as 50% under emergency conditions by working extra shifts. Bread production might be further increased by cutting down on the production of such fancy baked goods as cakes and pastries. One baker noted that this would be somewhat inefficient, because different ovens and handling equipment are required for the production of fancy baked goods.

Fruits and Vegetables. In general, fruit and vegetable carriers have little excess capacity. Most plants are organized to operate at peak capacity 24 hours per day throughout the harvest season for a particular crop.

Food Fats and Oils. Edible oil-processing plants generally operate around the clock seven days a week; hence the industry's emergency production capacity is only slighter greater than its normal preattack capacity.

Sugars and Sweets. The opportunity to bring about significant increases in emergency capacity in Colorado's beet sugar plants is limited. The cane sugar plants on the Atlantic Seaboard and the Gulf Coast, however, generally operate only one or two shifts five days per week. Hence it would be possible to nearly double cane sugar production if extra labor were available and sufficient cane supplies could be imported.

5.3.2.2 Capacity Conversion.

Postattack food-processing capabilities might also be increased by converting the production capacities of alternative technologies or abandoned facilities. Sobin and Bull (Reference 37) note that the nation's flour-milling capacity could be significantly enhanced by converting feed mills to flour production and using the grinding capacity of the hydraulic cement and phosphate rock industries. They estimate that the feed industry alone could "....add to bread flour production an amount of output equal to eight times the capacity of the flour-milling industry as ordinary measured."

Another example of potential capacity conversion can be found in the brewing and edible oil-processing industries. During prohibition, many breweries were converted to plants for the processing of edible fats and oils. A similar conversion might be effected following a nuclear attack should the nation's surviving edible oil processors be unable to meet postattack demand.

The conversion of alternative technologies to food-processing facilities is not a simple matter, and could not be accomplished immediately following an attack. Critical shortages in production capacity would have to be identified and matched with surplus or expendable capacities in suitable alternative industries. The conversion of materials-handling and -processing equipment in plants identified for conversion can be expected to require significant inputs of engineering calculation and labor. The logistics system supplying the substitute plant would undergo drastic changes. Thus, the expansion of food-processing capacities through the conversion of alternative technologies represents a long-term rather than a short-term solution to the problem of postattack food supply.

In recent years, the concentration of fluid milk production in the hands of a small number of large firms has led to the closing of many small dairies throughout the United States; this is particularly true in Colorado. In the Colorado Springs host area, for example, three dairies have closed in the last two years. Although the processing equipment in these dairies has fallen into disuse or been sold for use in other dairy operations, local industry officials cite the possibility of restoring the production capacity of these dairies should the postattack supply of milk be critical. The output per man-hour of these smaller dairies, of course, could be expected to be considerably less than the output in Denver's large present-day dairies. Nevertheless, two 700-gallon-per-hour dairies operating with used equipment could supply the emergency fluid milk requirements of all the Colorado Springs host and risk area surviving population.

5.3.2.3 Do-it-Yourself Processing.

For most commodities, the simplest means of overcoming a postattack processing bottleneck is to distribute the commodity in its unprocessed form. Most foods may be consumed without commercial processing. Fruits and vegetables are commonly distributed in both raw and processed forms. Raw wheat can be soaked and boiled to produce edible porridge. Should it be necessary to distribute raw commodities during the immediate postattack period, instructions for preparing the raw foodstuffs could be distributed with the food itself or broadcast via the radio.

The distribution of raw wheat could represent the most effective means of providing short-term sustenance for the surviving population during the immediate postattack period. Grain storage facilities in the Denver metropolitan area had a total capacity of slightly more than three million bushels as of August 30, 1975. An additional storage capacity of 65 million bushels was available within 100 miles of Denver. Colorado Springs elevators have a capacity of about 20,000 bushels.

The counties which comprise the Colorado Springs host area produce relatively little wheat: in an average year, less than 300,000 bushels. Grain storage capacity within the host area (including bulk and sacks) is about 656,000 bushels. However, these storage facilities are generally owned by feed manufacturers or dealers, and wheat is only a part of the total grain stored at these facilities at any time. It is estimated that the average level of wheat storage is about three to four million pounds. Based on NEC standards, this would provide cereal rations for the surviving Colorado Springs risk and host area population for about four weeks. Other grains stored in the host area -- such as corn and oats -- could also be utilized, but this would be unnecessary since very large quantities of wheat are in storage in other nearby Colorado counties, and wheat could easily be transported to the Colorado Springs host area.

In addition, if cereals were to be used as substitutes for other food in accordance with the factors listed in Table 5.2, these grain stocks would represent the equivalent of a 1.7 weeks supply of meat, eggs, milk, cereals, fats and oils, and potatoes to the Colorado Springs host and risk area surviving residents. Total Colorado grain supplies would last all Colorado survivors about seven months, assuming storage facilities were one-half full. The versatility of the grain supply reflected in these figures supports the observation of some researchers (References 37,33) that, from a nutritional standpoint, grain makes an acceptable short-term diet in itself. From a distribution standpoint, it is conceivable that grain may be the only foodstuff immediately accessible in significant quantities immediately following an attack in certain areas. In such an event, the dissemination of information regarding the preparation of raw grain (such as that contained in Reference 39) should accompany the distribution of the grain itself.

TABLE 5.2

LIST OF ACCEPTABLE FOOD SUBSTITUTES

NATIONAL EMERGENCY FOOD CONSUMPTION STANDARDS

Unit	Equivalent Unit	Substitute Foods or Food Groups
Meat and meat alternates	1/2 lb.	Cereal and cereal products
	1/4 lb.	Food fats and oils
1 pound	12	Eggs
	2-3/4 lb.	Potatoes
	2-1/2 pts.	Milk (fluid, whole)
Eggs	1/2 lb.	Meat and meat alternates
6 eggs	1/4 lb.	Cereal and cereal products
	1 pt.	Milk (fluid, whole)
Milk (fluid, whole)	2/5 lb.	Meat and meat alternates
1 pint	1/5 lb.	Cereal and cereal products
Cereal and cereal products	2 lbs.	Meat and meat alternates
1 pound	5 lbs.	Potatoes (white and sweet)
Food fats and oils	4 lbs.	Meat and meat alternates
1 pound	2 lbs.	Cereal and cereal products
Potatoes	1/5 lb.	Cereal and cereal products
1 pound	2 lbs.	Fruits and vegetables

Source: Reference 17.

5.3.3 Distribution Alternatives

In the aftermath of a nuclear attack, the distribution system might be altered by wholesaler substitution, by the construction of emergency warehouses, or by the establishment of mass-feeding centers.

5.3.3.1 Wholesaler Substitution.

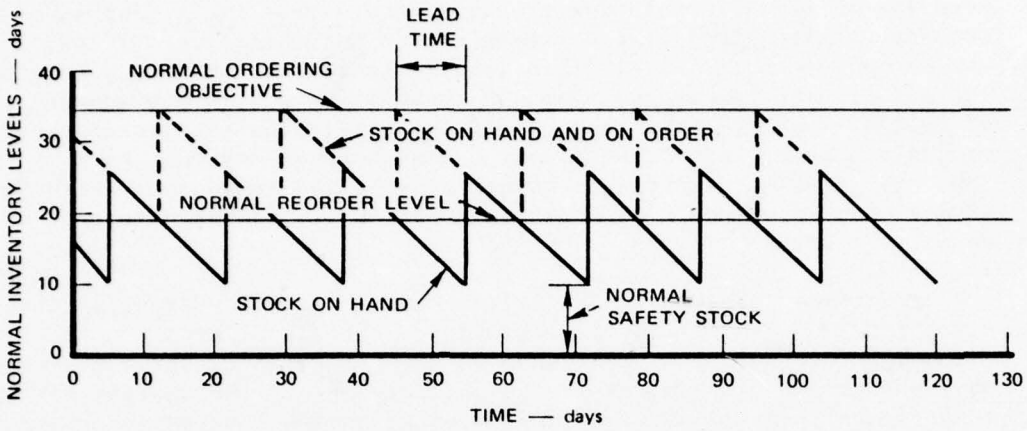
Under a process of wholesaler substitution, retail outlets whose normal sources of supply were destroyed in an attack would be reassigned to surviving wholesalers. Such reassignments might be made on the basis of both convenience and corporate identity.

Exhibit 5.1(a) depicts a profile of the inventory levels attained by a typical item in the normal course of operation of a wholesale distributor. Under the indicated system, stock is reordered when the stock on hand and on order falls below a predetermined level. New stocks are generally ordered in standard lots or economic order quantities that raise the total stock on hand and on order to the level designated as the normal ordering objective in Exhibit 5.1(a). The lead time indicated in this figure represents the total time from order placement to receipt of goods, and includes the time required to process records, transmit orders, and process or ship the ordered item. Denver wholesalers typically experience an average lead time of ten days.

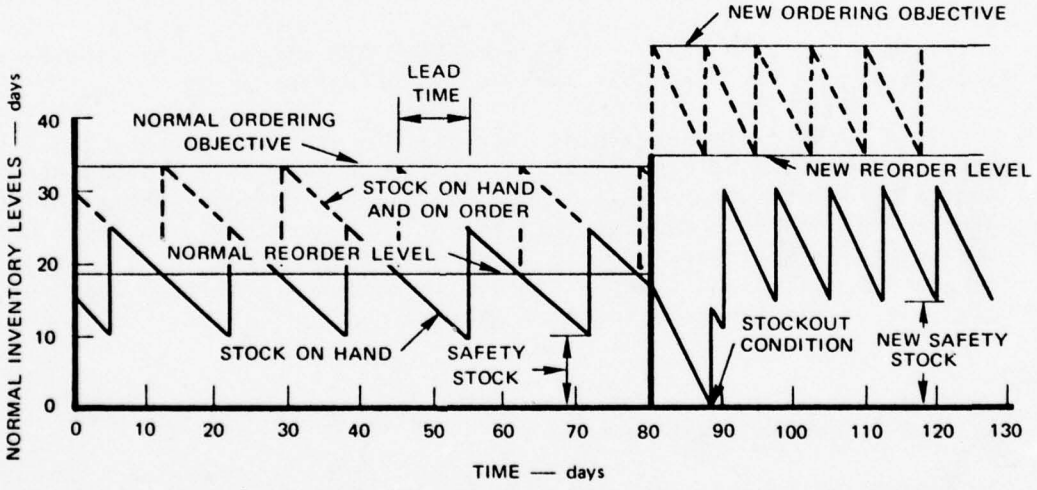
Because both lead times and demand rates vary, some measure of protection must be built into the inventory system to ensure against stockouts. This measure of protection is the safety stock indicated in Exhibit 5.1(b). The amount of safety stock carried for any item depends on (1) the degree of unpredictable variation in the demand rate, and (2) the mean and variance of the lead time.

The response of an inventory system to a sudden, recognized doubling of demand is depicted in Exhibit 5.1(b). If the retail outlets served by the wholesaler represented in this figure were to double suddenly, the wholesaler would immediately order more stocks from his suppliers and adjust his estimates of the safety stocks, reorder levels, and ordering objectives required to meet the anticipated demand increase. An immediate response offers no insurance against an immediate stockout situation, however, as the possibility of a stockout will be determined by existing lead times and previous safety stock levels.

Exhibit 5.1(b) highlights two of the operating limitations facing surviving wholesalers that attempt to expand their operations following a nuclear attack. The first limitation is the possibility of an immediate stockout. The danger of incurring an immediate "drying up" of inventory stocks before replenishments arrive will be heightened in the postattack period by the variability of resupply lead times. Wholesalers contacted in past investigations estimate that demand increases of 30% to 50% could be accommodated in normal times before serious stockout problems develop.



(a) NORMAL DEMAND PATTERN



(b) DEMAND DOUBLES ON DAY 80

EXHIBIT 5.1: TYPICAL ITEM INVENTORY PROFILES

(Source: Reference 12)

The second limitation on postattack wholesale operations indicated in Exhibit 5.1(b) stems from the increase in safety stock required in the face of increased demand. This increase may be interpreted as a need for additional warehouse storage space. The extent of this need depends on the nature of the items handled and the degree of lead time and demand variability. If lead time is considered constant, the need for additional storage space can be shown to vary with the square root of demand. As lead time variability increases, the relationship between demand and safety stock approaches a linear relationship. At a minimum, then, the need for storage space can be expected to increase with the square root of demand. At most, this need will increase linearly with demand.

Past research (References 2, 12) has shown that most major wholesalers located within large central cities operate at or near capacity. Although newer warehouse complexes on the outskirts of large cities may have a little more room for expansion, only one of the wholesalers interviewed in past investigations thought that his warehouse could accommodate a throughput increase in excess of 50% without undergoing major expansion.

A third limitation on wholesaler activity is imposed by the availability of labor, equipment and dock space. This varies markedly from warehouse to warehouse, and can only be assessed through direct visits and interviews. In most cases, however, it is doubtful whether handling activities could be increased by more than 50% without experiencing crew interference in the critical loading and unloading areas.

Although small incremental increases in warehouse throughput would require little adjustment on the part of a wholesaler, it would seem that a practical upper limit on the additional business that a wholesaler could handle in case of emergency might be set between 30% and 50% of his normal business. In the short run, the wholesaler attempting to expand his operations will be faced with stockout problems, which will give way in the long run to space limitations.

5.3.3.2 Emergency Warehouses.

Food distribution capacity can also be augmented by establishing new wholesale warehouses outside the central city. The new warehouses might be converted from available unused buildings, commandeered from less critical industries, built as quickly as possible after the attack, or prepared and equipped in advance. Each of these alternatives is explored briefly in this subsection, together with indications of labor and equipment needs, potential operating efficiency, and preattack cost to the government.

Converted and Commandeered Space. At any given time, a certain number of buildings outside the central city are empty and available for use. Information about the identification, location and suitability of such buildings may be obtained from plant location directories, county

assessors' offices, or real estate leasing agents and owners. Discussions with the assessor's office and leasing agents in Fort Collins, Larimer County, Colorado, for example, revealed that five buildings suitable for dry grocery warehousing are located in and around Fort Collins, with a total area of 400,000 square feet. However, only one of these buildings was completely empty, and it was expected that it would soon be leased. Some of the other buildings, however, were not completely utilized, so that a total of about 50% of their space could be considered available. The available space is about 12 percent of the major chain's dry grocery capacity.

The available buildings typically have some sort of overhead handling equipment and some truck and/or rail docks. If operated as distribution warehouses, the holding capacity of these buildings would be less than their area suggests, because of stacking height limitations and the lack of storage racks and other fixtures. Thus, on the average, one might expect the available area to be one-half as useful as distribution warehouse space, or equivalent to only 6 percent of the major chain's capacity (i.e., about 100,000 square feet).

The gross volume of food products handled through these buildings will depend partly on the ability to load and unload trucks. This in turn will depend on the availability of materials-handling equipment and transportation to spot trailers and railcars. Assuming adequate transportation equipment, the following loading and unloading rates can be used for existing truck and rail docks:

Manual	10,000 pounds per hour
Hand truck	20,000 pounds per hour
Forklift	40,000 pounds per hour

Shortages of truck and rail dock facilities can be overcome by improvisation, but at a significant reduction in loading and unloading rates. Through a ground level access opening, unloading would have to be performed largely by hand and could proceed at a rate of about 5,000 pounds per hour.

If it is assumed that there is at least one truck loading space for each 24,000 feet of floor space, the 200,000 feet available in the Fort Collins buildings would have about 14 truck loading spaces. Assuming that one-half of these are active at a time and that crews are 75% effective and work 24 hours per day, 375 days per year, then the available buildings could handle 115,000 tons annually with manual unloading and 450,000 tons annually with forklift unloading. (This assumes only pallet loads are handled in the warehouses.) Under normal conditions, a 200,000 square-foot chain warehouse can handle a throughput of 1,000 tons per week, assuming one shift, five days per week. If shifts were increased to three and a seven-day work week adopted, the throughput could increase to 182,000 tons per year. Handling only pallet loads in the warehouse would increase this possible throughput by 2.5 times (455,000 per year). The throughput for the above-mentioned 200,000

square feet of available space would, of course, be less than that for a warehouse designed for dry grocery handling. It is assumed that the available host-area space will be about half as useful as the Denver warehouses.

Labor requirements for the five warehouses would be 50 to 100 workers if the working year were limited to 2,000 staff-hours per worker. The exact number would depend on the availability of mechanical equipment, the actual suitability of the buildings, and postattack labor efficiency. The actual length of the working day would vary depending on radiation hazards, the available workforce, transportation and other factors.

Under this option, the balance of needed warehouse space would be commandeered. The dry grocery area of the Denver food chains is about 1,742,000 square feet. Under emergency loading conditions, it is assumed that there would be three shifts working seven days per week. Also, pallet loading would allow a greater throughput factor (i.e., about 2.5 times the normal rate). Additional shifts, increased throughput per shift, coupled with the 50% efficiency of converted space, would indicate a need for 800,000 to 1,000,000 square feet of space to achieve a throughput equivalent to that of the Denver warehouses. This would be four to five buildings with about 200,000 square feet each. The total workforce required would be on the order of 300 to 600 workers.

Emergency Construction of New Warehouses. The second option is to build new warehouses on an emergency basis after the postulated attack. This option provides postattack choice of location, with the likely result that transportation needs could be minimized. Offsetting this clear advantage are problems of material acquisition and the availability of construction equipment and labor.

Postattack requirements would not be a one-for-one replacement of lost facilities, since some improved efficiency could be realized by grouping products and, wherever possible, handling only pallet loads. Because of pallet loading, added shifts and longer work weeks, a volume roughly equivalent to that of the preattack period could be attained with less floor space.

Emergency warehouses would probably be one-story, tilt-up constructions erected on slab floors or Butler-type buildings. If plans and material requisitions were prepared in advance, these buildings might be constructed in a period of four to eight weeks, provided necessary materials were available. Stocking would require the average ten-day lead time currently experienced by warehouse operators. The workforce required to construct four warehouses of 400,000 square feet each might number 600 to 1,000 workers, at a cost of about $10.8 million.

Preattack costs would be limited to the preparation of designs and bills of material. It would be advantageous to stockpile general purpose materials-handling equipment such as forklift trucks, pallets, dock boards, and pallet racks in the host area during the crisis relocation period.

Preattack Warehouse Construction. To avoid the uncertainties of postattack material availability, several emergency distribution warehouses might be built in the host area now and equipped for postattack use. This option presents several problems, however, the most important of which is the choice of sites. To ensure minimum attack damage, it would be preferable to build a large number of moderate-sized warehouses that are widely dispersed. The postattack consequences of this policy of dispersal are only moderate efficiency and limited transportation penalties.

Comparison of Options. The warehouse options and evaluation criteria discussed above are summarized in Table 5.3. As is the case for other elements of the potential postattack food distribution system, the selection of local storage options entails trade-offs between the extent of preattack preparation and the likelihood of effective postattack performance.

Although generalizations are difficult in light of the potentially wide range of postattack conditions faced by localities, it appears that converted or commandeered space is the most attractive of the local storage options in the immediate postattack period. The option requires negligible preattack investment and several suitable buildings are likely to survive attack in the host areas where population survival is high.

Mass Feeding. Mass feeding represents a basic emergency alternative to food distribution and, as such, has long been recognized as an integral part of a national disaster preparedness program. Mass feeding procedures have been established as part of crisis relocation planning (Reference 2). It is possible that, due to the destruction of traditional channels of food distribution, mass feeding operations may have to be expanded in the postattack period. In addition to Reference 2, which considers mass feeding in the context of crisis relocation planning, information on mass feeding programs has been published jointly by the Office of Civil Defense, the American National Red Cross, and the Department of Health, Education and Welfare (Reference 40).

5.3.4 Transportation Alternatives

Virtually all food is transported by either truck or rail. Approximately 97% of all food products carried in intercity traffic goes by rail or truck, with rail accounting for about 66% and truck 31%. More meat and dairy products are carried by truck, whereas a greater share of canned goods and other food products travel by rail. Overall, food products account for 25% of rail and 22% of truck intercity ton-miles. Locally, food products move almost exclusively by truck.

TABLE 5.3

OPTIONS FOR LOCAL POSTATTACK WAREHOUSING OF PROCESSED FOODS

	Warehouse Substitution	Commandeered Space	Emergency Construction	Preattack Construction
Concept	Surviving food wholesalers would undertake distribution to retail outlets whose wholesalers were damaged or destroyed by attack.	Empty buildings or nonfood wholesale facilities would be converted for use as food warehouses after attack.	New food warehouses would be constructed in the immediate postattack period.	Warehouses would be constructed on a contingency basis before attack.
Preattack requirements	Negligible	Maintenance of an accurate inventory of available and suitable buildings.	Preparation of building plans and material requisitions. May be advantageous to stockpile materials-handling equipment.	Multimillion dollar expenditures (on a national basis) for constructing and equipping warehouses.
Vulnerability to damage	Existing food wholesale warehouses have been shown to be very vulnerable to attack.	Vulnerability is a consideration in preattack identification of suitable buildings.	Negligible	Vulnerability is a critical determinant in site selection. There is a high risk that facilities sited on the basis of transportation considerations would be damaged by attack.
Postattack operating requirements	Requires the establishment of new wholesale to retail distribution patterns in a time of great stress.	Commandeered structures may require modification for effective use as food warehouses. Materials-handling equipment may also be needed. needed. A larger than normal work force is likely to overcome shortcomings.	Substantial requirements for labor and materials to construct new warehouses.	If facilities are sited at remote locations to minimize vulnerability, extra postattack transportation needs would result.
System performance	For many U.S. cities, it is likely that reliance upon this option alone would not remedy loss of warehouse space. It appears that a practical upper limit on additional output by surviving wholesalers is between 30% and 50% of normal business.	A shortage of refrigerated space is likely. System performance will be slowed if commandeered space is not well sited to accommodate transportation vehicles and not well equipped for the handling of food supplies.	Minimum of four to eight weeks after attack before new facilities could become operative.	Surviving facilities would be available immediately after attack to receive food supplies.

Source: Reference 5, updated by SYSTAN.

5.3.4.1 National Situation.

While damage to rail and highway transport systems resulting from an attack will be substantial, earlier research (References 12, 45, 46) has concluded that "the surviving aggregate inventories of such items as motor trucks, locomotives, railroad classification yards, and experienced workers appeared to be more than adequate for deliveries of food and other essentials" (Reference 12). While this statement applies to an in-place protection mode, it would be essentially unchanged for the crisis relocation situation. In fact, the survival of critical vehicles can be expected to be greater under a crisis relocation strategy.

At the national level, previous studies (References 45 and 46) have determined that for the range of attacks studied, major rail and highway links were cut in every major city targeted. In almost every case, however, alternative detour routes existed around these breaks. Following all but the heaviest attacks studied, it would be possible to move goods from almost any undamaged point to any other undamaged point by rail or road. UNCLEX-Charlie attack data on damage to rail and highway networks is classified and therefore unavailable for this report. However, based on a four-state sampling undertaken by SYSTAN, it was determined that in order to avoid damaged or fallout-contaminated areas, highway vehicles would have to travel between 15% and 35% farther than under normal preattack conditions.

Truck accessibility at D+30, based on the UNCLEX-Charlie pattern, is approximately 56%. Under crisis relocation, however, most trucks would be moved to the host area and the accessibility rate would be much higher. Railroad rolling stock accessibility at D+30 is: freightcars, 42%; line-haul locomotives, 56%; and switching locomotives, 37%. However, rail rolling stock accessibility immediately after the attack is considerably less, ranging from 25% to 34%. Moreover, the rail network is likely to be far less resiliant than the truck network immediately following an attack, indicating a need for increased reliance on truck transport during the first few postattack weeks.

In the event of an attack, U.S. fuel production and storage facilities would suffer relatively heavy damage. Based on the UNCLEX-Charlie attack, overall refinery production capacity for use at D+30 would be about 31%. Accessible gasoline production would be about 35% and diesel 25%. At D+180, refinery facilities representing an additional 31% of total production would be accessible for repair (Reference 47).

With relatively heavy damage to U.S. refining capacity, fuel supplies could be a potential bottleneck in the postattack period. However, it appears that with the restriction of personal travel and non-essential cargo transport, there will be sufficient fuel for the transport of food and other essential goods. Fuel supply and consumption in the postattack period is analyzed more fully in the SYSTAN report, "Postattack Impacts of the Crisis Relocation Strategy on Transportation Systems" (Reference 51).

5.3.4.2 Colorado Situation.

At the local level, early studies indicated that most major urban areas would have limited rail and road accessibility immediately following a nuclear attack. Later studies (References 49 and 50) focused on local transportation needs in specific urban areas. In a study of rail activity centers in 12 U.S. cities, Jones (Reference 49) concluded that food could be delivered by rail to within a few miles of nuclear attack survivors in each case studied, despite significant damage to the rail resources of many of the cities.

All of the railroad terminals in Denver and Colorado Springs would receive moderate to heavy blast damage. The yards of the lines serving Denver (i.e., Burlington, Northern-Colorado and Southern, Denver Rio Grande and Western-Rock Island, Union Pacific and AT&SF) all receive blast overpressure of more than 10 psi. The lines serving Colorado Springs (i.e., Denver Rio Grande and Western AT&SF) receive blast overpressure of more than 5 psi.

Because of this relatively heavy damage to rail facilities, Denver could expect to undergo a critical curtailment of rail service in the immediate postattack period, while the surviving aggregate inventories of locomotives, classification yards, and train crews are recomposed into an operating system.

Should such delays occur, commodity movements most heavily-dependent on rail movement would suffer the most. Overall, about two-thirds of total food volume is shipped to Denver via truck, and about one-third by rail. Table 5.4 shows the estimated share of various food commodities moving into Denver and rail and by truck. Food moving to Colorado Springs from Denver goes almost exclusively by truck. Major truck roads into the Denver MA would also be disrupted by a nuclear attack. This is thought to be less serious than the disruption of rail service, because trucks are inherently more adaptable than trains and the road network surrounding Denver is more redundant than the rail network. Even so, the efficient shipment of food by truck into Denver will require effective planning and management. The need for effective planning and management of truck movements will be no less than that required for rail movement if sufficient supplies of food are to move by road into Denver during the immediate postattack period.

Because of damage to local food processors, some processing will have to be done outside the local area. Converting Colorado-produced fluid milk to dry milk, for example, would have to be done in Utah or Idaho. Total mileage would almost double and total vehicle-miles for milk processing would increase about 90% over the crisis relocation period.

Colorado's fuel supply would survive the postulated attack at about 60% of the preattack level. On this basis, cargo vehicle fuel usage could return to its preattack level, if fuel for work were restricted to 75% of "normal" and family business and recreation were restricted in the manner prescribed following the relocation effort. Under these

TABLE 5.4

ESTIMATED PERCENTAGE OF FOOD COMMODITIES MOVING BY RAIL AND TRUCK INTO DENVER

COMMODITY GROUP	MODE	
	Truck	Rail
Meat		
Raw Supply	95	5
Processed Supply	80	20
Milk		
Supply	100	--
Processed Supply	100	--
Eggs		
Raw Supply	100	--
Processed Supply	--	--
Cereals & Cereal Products		
Raw Supply	15	85
Processed (milling, preparation)	30	70
Processed (bread, baking)	100	--
Fruits & Vegetables		
Raw Supply	90	10
Processed Supply	50	50
Fats & Oils		
Raw Supply	90	10
Processed Supply	50	50
Potatoes		
Raw Supply	99	1
Processed Supply	90	10
Sugars & Sweets		
Raw Supply	--	--
Processed Supply	90	10

conditions, it may be assumed that there would be sufficient fuel for all necessary food transport. Colorado fuel supply and consumption are discussed in more detail in SYSTAN's postattack transportation study (Reference 51).

5.3.4.3 Alternatives.

The simplest transportation alternative that might be adopted following a nuclear attack would entail the use of detour routings to avoid roadways and railways that have been damaged by blast or blocked by debris. The use of detour routings could be required in both long-haul and short-haul shipping following a nuclear attack.

The greater flexibility of truck movement in time of emergency suggests that truck movement might be effectively substituted for rail movement during the immediate postattack period. The major commodities coming into Denver by rail are wheat and other cereal products and canned goods (usually in palletized form); these items can readily be carried by truck. To ensure the most efficient use of fuel and manpower, such substitutions of service would usually be made on relatively short hauls. Furthermore, the railroads should resume their ordinary role once rail service is reestablished.

In addition to detour routings and modal substitution alternatives, strategies identified for improving driver and vehicle productivity under emergency conditions are discussed below.

As part of earlier studies (References 2, 5, 12), distribution managers for major food wholesalers serving each of the areas indicated in Table 4.10 were interviewed at some length regarding potential measures that might be employed to ease the transportation stress imposed on the food distribution system by a crisis relocation. Similar interviews were carried out in the case of motor fuel distributors serving Colorado Springs. Most of the distribution managers interviewed felt that the vehicle mileage covered by their truck fleets in making local deliveries could be doubled under emergency conditions; additional increases would require additional equipment. The larger food distributors interviewed indicated a willingness to lease additional equipment in time of emergency; this is their current practice when demand surges render their truck fleets inadequate. Many gasoline distributors rely heavily upon public carriers under normal circumstances, and would follow this strategy instinctively during an emergency. Additional strategies for increasing truck and driver productivity include:

1. RELAXING REGULATORY CONSTRAINTS

   a) Relaxing union and DOT driver restrictions

   b) Ignoring over-the-road weight limitations

2. IMPROVING UTILIZATION OF EXISTING EQUIPMENT

a) Relaxing maintenance requirements

b) Minimizing downtime

c) Shipping only full-pallet loads of commodities

d) Eliminating light loads

e) Shipping only necessary commodities

3. OBTAINING ADDITIONAL EQUIPMENT AND DRIVERS

a) Leasing equipment

b) Using incoming equipment from manufacturers

c) Commandeering additional drivers and equipment from less critical sectors of the economy

Each of these strategies is discussed in greater detail in "Impacts of the Crisis Relocation Strategy on Transportation Systems" (Reference 51).

5.3.4.4 Summary.

Although damage to motor vehicles and rail facilities within the risk area would be relatively heavy, most trucks would be moved to the host area during relocation. Hence, it appears that there would be a sufficient number of cargo vehicles for the transport of food and other essential goods in the immediate postattack period.

Fuel may be a problem, although there will be enough fuel to support food movements if fuel use is carefully rationed.

Damage to roadways and railways will mean that, during the immediate postattack period, trucks will have to carry that food normally carried by rail.

5.4 SUMMARY OF POSTATTACK ALTERNATIVES

Several alternatives which may be implemented during the postattack period have been discussed above. In the long run, both the national food distribution system and its local Colorado counterpart appear to be sufficiently flexible to adapt to a wide range of postattack conditions.

At the supply end of the distribution system, aggregate production during the first postattack year is likely to fall short of demand if the attack has been preceded by a successful evacuation. However, stockpiled grain products may be used as a substitute for other less

plentiful products. In the past, food for survivors of localized disasters has often been obtained from government stockpiles maintained by the USDA as part of its Donated Commodities Program. This program, however, has been curtailed in recent years. Some limited supplies of selected commodities (such as wheat, dried milk and peanut oil) are still held in private warehouses under USDA/ASCS agreements, and are available for emergency use. These supplies should be moved out of high-risk areas (where necessary) during the crisis relocation period. As noted above, however, the movement of any stocks that have already been turned over to state or local agencies would be controlled by those agencies. Food stored under the School Lunch Program should also be moved to the host area.

Quantitative studies of food-processing industries indicate that the overall survival rate of food processors is roughly half that of the national population under a strategy of crisis relocation. At the local level, dairies and bakeries are particularly vulnerable to population-based attacks. Postattack food-processing capacity will be enhanced by the ability of many surviving plants to expand their output beyond preattack levels by simplifying production processing, increasing employment or the number of shifts worked, or relaxing quality control tolerances. Surviving milk-processing plants, for example, could probably almost double their output by increasing the number of hours and days worked. In some instances, alternative technologies might be converted to the production of food following a nuclear attack. For example, feed mills could convert to producing whole-wheat flour. Also, for any food that can be distributed in its raw form--and most foods can--food processing capability should never be allowed to become a serious distribution bottleneck following an attack. Soaked and boiled wheat, for example, can provide an adequate form of nourishment.

At the local level, postattack distribution problems pose the most serious potential constriction in the food supply channel. Host-area retailers will need to be resupplied within 14 days after the attack, and mass feeding centers will need to be resupplied almost immediately. However, the primary preattack source of supply for these outlets -- the risk-area wholesaler -- will suffer heavy attack damage. One way of dealing with this problem is wholesaler substitution, in which retail outlets whose normal sources of supply were destroyed in an attack would be reassigned to surviving wholesalers.

Food distribution can also be augmented by establishing new wholesale warehouses outside the destroyed risk areas. The new warehouses might be converted from available, unused buildings, commandeered from less critical industries, or built as quickly as possible after the attack.

Considering the potentially wide range of postattack conditions, it appears that converted or commandeered space is the most attractive of the local storage options during the immediate postattack period. This option requires negligible preattack investment, and several suitable buildings outside the high-risk area are likely to survive the attack.

In the likely event that the ratio of surviving population to surviving warehouse facilities is unfavorable, supplies for mass-feeding centers could come partly from surviving stockpiles of processed commodities moved to the host area during relocation and from Colorado's ample grain and potato resources. The need for mass-feeding programs may not extend more than one month beyond the attack date, but it seems probable that such programs will be needed and that the need will be critical from the standpoint of both morale and nourishment. If this need is to be met effectively during the immediate postattack period, the corresponding need for training recruits and planning mass-feeding operations must be met well in advance of any attack.

6. IMPLICATIONS OF POSTATTACK RESEARCH ON PREATTACK CRP GUIDELINES

The results of the postattack research in the Colorado Springs study area have been reviewed in the light of the current guidance for crisis relocation planning (Reference 2). As a result of this review, it appeared that the basic strategy proposed for food distribution under crisis relocation conditions was sound, even though the continued use of risk-area warehouses left this element of the distribution system vulnerable to attack. However, the analysis accompanying the damage assessment and evaluation procedures brought to light several elements which should be included in the crisis relocation guidance issued by the federal government and in the crisis relocation plans for specific areas. These elements include:

1. Provision for identifying critical stockpiles of food outside normal distribution channels within the risk area and moving these stockpiles to the host area;

2. Provision for identifying host-area buildings which might be converted to food warehouses under emergency conditions and estimating the utility of such converted space;

3. Guidelines for expanding the capacity of existing food processing plants and converting the capacity of other plants to expand the production of critical commodities under crisis relocation conditions; and

4. Guidelines for anticipating postattack shortages of specific commodities and adjusting priorities for shipments during the crisis relocation period accordingly.

6.1 STOCKPILES

Several planning functions should be undertaken during the formulation of the guidelines for each state. One of these is planning for the transfer of USDA/ASCS stocks and other raw food stockpiles from high-risk to host areas. The commodities held in storage under USDA/ASCS authorization are dried milk, butter, cheese, wheat, rice and peanut oil. One critical commodity which will be in short supply during the postattack period is milk. Therefore, USDA/ASCS dried milk should be removed during relocation from the high-risk areas to the host areas. Locating the commodity (in this case, dried milk), estimating the quantities involved, and arranging for the transfer of significant stocks to the host area should therefore be part of the planning process and included in the Food Annex. To aid in the preparation of plans for moving stockpiles, a listing of current USDA/ASCS stockpile locations has been included in the food guidelines accompanying this report. Similar procedures should also be applied in the case of raw or processed commodities stockpiled in significant quantities in risk areas, whether or not the stockpiles are government-owned. This is particularly true of grain stored in risk-area terminals, particularly in grain-deficit areas such as New England.

6.2 CAPACITY EXPANSION

Capacity expansion of various kinds of processing activities have been discussed in detail in Chapter 4 and in summary form in the first part of this chapter. Discussion by state and local planners with industry personnel will provide data to planners on local capacity expansion capability. In addition, such discussions will introduce industry officials to civil defense thinking and provide them with some conception of what will be expected of them in the event of a crisis situation.

Thus, although the present guidelines state that output should be expanded where possible, local guidelines should be revised to reflect the specific food requirements of the risk and host area populations (e.g., an increase in flour production and the storage of such extra production in available buildings within the host area). Similarly, the probable shortage of fluid milk processing capability during the postattack period has been well documented. Thus, guidelines should suggest that canned milk plants increase their output and that additional output be stored within the host area.

6.3 CAPACITY CONVERSION

Another activity which can be included in local plans is that of capacity conversion during and after the crisis relocation period. For example, a substantial portion of the capacity of milk-drying plants in Idaho and Utah are utilized in processing whey for animal consumption. Upon relocation, production could be immediately converted (with no essential physical plant changes) to producing additional dried milk; such dried milk could then be stored within the host area. In addition, as discussed in Section 5.3, host-area dairies which have been closed in recent years could be reactivated with used equipment. Host-area plans should identify not only currently-operating dairies, but also recently-closed dairies which might be reactivated in time of preattack crisis.

In addition, depending upon anticipated requirements, feed milling --which is often carried on in conjunction with elevator operations--can be utilized for grinding wheat into meal and coarse whole wheat flour. If necessary, this supply could then supplement the concurrently-expanded flour milling output.

6.4 WAREHOUSING

Several types of warehouse options have been described earlier in this chapter. A review of these options suggests that few changes need to be made in current CRP guidance as a result of postattack research. However, in view of the vulnerability of risk-area warehouses, each host area plan should contain a listing of suitable host-area structures.

6.4.1 Wholesale Warehouses in Risk Areas.

The alternative of maintaining wholesale operations within the risk area has been discussed in the Food Guidelines (Reference 2). It was pointed out in that document that a number of factors favor a food distribution strategy in which the distributors continue to operate risk-area warehouses. This strategy has several attractive features: The altered system is conceptually simple, and builds intelligently on the existing system without creating new operating entities. Corporate chains are preserved as distribution limits, and most host area retail stores will continue to be supplied by their pre-evacuation sources. Strain on the national distribution system is minimized, and supplies on the road from national processors to regional and local wholesalers at the time of evacuation need not be rerouted.

As discussed in Reference 2, an alternative to the continued use of risk-area warehouses entails the establishment of emergency warehouses and break-bulk centers within the host area. This option has the advantage of decreasing the vulnerability of wholesale food supplies to attack, with accompanying disadvantages of operating inefficiencies, system disruption, and delays in reestablishing normal operations in the event that no attack occurs. In addition, it is difficult to locate suitable structures in the host area, and previous research has determined that new construction would require at least three weeks. One significant argument against the use of host-area warehouse space is the length of time required to empty existing risk-area warehouses. Food industry personnel estimated that they would require a minimum of four days to a maximum of two weeks to empty existing warehouses using current personnel and equipment. The average estimated emptying time was one week. Since the risk area warehouses will be operating throughout most of the expected duration of a crisis relocation, whether or not they supply retail outlets or emergency wholesale warehouses in the host area, they may as well function in their normal mode as a supplier of retail outlets. This eliminates an extra, inefficient step in the distribution process.

As noted in Reference 2, however, it is possible that plans to drain wholesale warehouses immediately following the start of a crisis relocation might be applied successfully in the case of smaller risk-area wholesalers. Should the crisis period extend beyond the three days required for relocation, moreover, selected large wholesalers might begin to relocate their stocks to suitable host-area facilities.

In general, based on a review of the postattack situation, there does not appear to be any cause for suggesting that the option of maintaining risk-area wholesale operations should not be followedduring the relocation period. Should an attack occur, it appears that a combination of surviving warehouses, existing host-area warehouses, converted or commandeered space and, where necessary, new emergency construction will meet postattack wholesale distribution requirements. Planning for the use of existing host-area warehouses is discussed later in this chapter. 'Host-Area Warehouses.' As noted above, stockpiles of certain critical foodstuffs should be moved out of the high-risk area during the

relocation period. These commodities will have to be stored in host area warehouses or other suitable structures. Therefore, a list of such warehouses or structures should be part of each crisis relocation plan. The list should include such information about each structure as:

1. Location;
2. Area (square feet by floor);
3. Dimensions;
4. Loading dock data;
5. Inside ceiling clearance;
6. Temperature control; and
7. Type of material used in construction.

In the event of an extended crisis relocation period, such a list of warehouses could be used in two ways: (1) in selection of suitable host-area storage facilities for foodstuffs stockpiled in the risk area and being moved to the host area during crisis relocation, and (2) in the selection of suitable host-area warehouses for smaller wholesale operations. Data on warehouses and other potential storage structures should be prepared and made a part of the food annex sections of host-area crisis relocation plans.

If the initial crisis relocation is not followed by an attack or a cessation of hostilities, an extended relocation period may result in which risk-area residents reside for relatively long periods of time in the host area. In the event such an extended relocation period occurs, suitable structures in the host area might be gradually filled with processed foods and worked into the food distribution network. In this way, a shift from risk-area to host-area warehouses could gradually occur under conditions of extended crisis. Further discussion of the extended crisis situation may be found in a recent SYSTAN report on emergency transportation alternatives (Reference 51).

6.5 RELATIVE VULNERABILITY OF FOOD COMMODITIES

Postattack research has shown that certain food items are more vulnerable to nuclear attack than others. The relative vulnerability of the eight primary food commodities of meat, milk, eggs, cereals, fruits and vegetables, fats and oils, potatoes, and sugars is summarized in Exhibit 6.1. This exhibit ranks the vulnerability of the production, processing, and storage elements for each of these commodities, and assesses their probable availability and accessibility following an attack on the basis of past research.

EXHIBIT 6.1: RELATIVE NATIONWIDE VULNERABILITY OF CRITICAL FOOD COMMODITIES

Commodity	Projected Attack Damage			Likely Postattack Availability and Accessibility	
	Production Capability	Processing Capability	Stockpiles	Short-Term	Long-Term
Meat	Moderate	Moderate-Heavy	No Significant Stockpiles	Severe Shortage	Shortage
Milk	Moderate	Moderate-Heavy	No Significant Stockpiles	Severe Shortage	Shortage
Eggs	Moderate	Moderate	No Significant Stockpiles	Shortage	Slight Shortage
Cereals	Light*	Moderate-Heavy	Light-Moderate	Severe shortages of processed stocks; ample supplies of raw grain, which will require transportation.	Sufficient Stock
Fruits and Vegetables	Light-Moderate	Light-Moderate	No Significant Stockpiles	Slight Shortages	Sufficient Stock
Food Fats and Oils	Light	Moderate-Heavy	Moderate	Slight Shortages	Sufficient Stock
Potatoes	Light*	Light-Moderate	Light	Slight Shortages	Sufficient Stock
Sugar	Light*	Moderate-Heavy	Moderate	Slight Shortages	Sufficient Stock

*Damage is light if attack occurs any time other than the early growth and reproductive stages following planting. If an attack occurs when the crop is in this vulnerable stage (around early June), damage will be moderate to heavy. Heaviest damage to soybeans will be in August.

LEGEND

Damage	Percent Surviving	Damage	Percent Surviving
Light	80-100%	Moderate-Heavy	40-50%
Light-Moderate	70-50%	Heavy	0-40%
Moderate	50-70%		

(Percentage figures are for D+30)

These rough rankings should be included in the guidance provided to local planners, in the hope that they might aid these planners in making any priority judgements which might arise in the course of a crisis relocation. Faced with the choice of evacuating a supply of dried milk or a supply of sugar from the risk area, for example, the planner should concentrate first on the milk, which is expected to be in short supply immediately following an attack.

6.6 SUMMARY OF PREATTACK IMPLICATIONS

A review of the implications of the indicated changes on preattack crisis relocation guidelines has resulted in the identification of several important measures which should be taken during the preattack period. One of these is the identification and planning for the transfer (during relocation) of USDA/ASCS food stocks from high-risk areas to the host areas. Dried milk and grains are two important commodities which are held in risk areas by USDA/ASCS and private concerns and which should be transferred to the host area.

Plans to increase food processing capacity where possible during the crisis relocation period should be prepared and included as part of the food annex of each local plan. Expansion of such processes as flour milling and milk processing should be planned where appropriate, and additional output should be stored within the host areas.

Capacity conversion is an effective measure for alleviating food shortages which should also be planned in advance and implemented during the crisis relocation period. As indicated above, a number of smaller local milk processing plants, often in host areas, have gone out of business and been abandoned or used as distribution centers. When necessary, these facilities could be reactivated with used equipment.

Host-area warehouse space should be identified and such information included in the pre-crisis planning. Some space suitable for warehousing is usually available within the host area. The list of facilities should include: address, area of each floor, dimensions, inside ceiling clearance, type of material used and other pertinent information.

7. FIELD TESTS OF PLANNING GUIDELINES AND FOOD PROTOTYPE PLANS

7.1 INTRODUCTION

During the final stages of the research, field tests were conducted in an attempt to validate the guidelines and plans contained in Volumes II and III of this report. These field tests took the form of interviews with planners and industry personnel designed to validate the approach and materials, and to elicit comments and data regarding the subject matter. Specific information from these interviews has been incorporated in the final versions of the case studies, planning guidelines, and prototype plans constituting the three volumes of this report. This chapter outlines the subject areas included in the field tests, the general approach to the respondents, a summary of the responses, and conclusions and recommendations.

The general objective of the field test program was to evaluate how well the planning guidelines and prototype plans met, at a minimum, the following criteria:

1. The guidelines should be understandable and usable by the DCPA regional, state and local personnel who will be developing plans for their own jurisdictions; and

2. The plans themselves must make sense to the food industry officials whose job it will be to implement the plans under crisis conditions.

These dual criteria suggested that testing of plans and guidelines would require contact both with DCPA planners and with industry personnel. Accordingly, separate interview programs were undertaken at two levels:

1. The planning level (DCPA regional, state and local planners); and

2. The implementation level (food industry personnel).

7.2 VALIDATION AT THE PLANNING LEVEL

To validate the guidelines at the planning level, SYSTAN personnel interviewed selected DCPA regional, state and local personnel involved in nuclear civil protection planning to secure their views, inputs, and recommendations on the developed guidelines. Interviews were conducted in three regions, selected jointly by DCPA and SYSTAN to cover a representative range of planning experience, both geographically and functionally. The three regions were DCPA Region III (headquarters in Thomasville, Georgia), Region VI (headquarters in Denver, Colorado), and Region VII (headquarters in Santa Rosa, California). A variety of state

and local planners were present at these meetings, and each meeting was preceded by a series of telephone contacts eliciting information regarding the planners' experience with the guidelines. In conjunction with these meetings, SYSTAN also obtained and reviewed draft food plans from Florida, Minnesota, and Arizona.

7.2.1 Approach Overview

Most of the respondents were familiar with the earlier food planning guidance (Reference 2), and had working experience in applying that guidance to their particular problems. Generally, the roles of these individuals were known to the SYSTAN staff.

A variety of approaches was used in gathering information from DCPA planners. In most instances, individual telephone interviews were followed by an informal round-table discussion with the planners in the region. In one instance (Region VI), a formal presentation was delivered to a meeting of state DCPA representatives. Whatever the approach, the information sought was the same in all cases:

1. Description of the individual's role in crisis relocation planning;
2. Exploration of past experience with crisis relocation planning guidance and prototype materials;
3. Discussion of specific problems encountered in using guidance to develop crisis relocation plans;
4. Reaction to key elements of revised postattack guidance;
5. Discussion of impact of planning materials on respondent's activities;
6. Solicitation of additional data and suggests for improvements; and
7. Derivation of conclusions regarding the materials.

7.2.2 Summary of Sample Planner Comments

The following list of comments summarizes the major reactions to the planning process in general, and food guidance in particular, elicited from DCPA planners during the review process. SYSTAN's observations on each comment are included in the list. Additional conclusions and recommendations appear in subsequent sections of this chapter.

GENERAL COMMENTS ON ALL DCPA CRP GUIDANCE

Planner Comment: The material provided is too detailed...There's too much for the planner to plow through and absorb.

Observation: This comment was the single observation heard most often, and was echoed by almost every planner interviewed. The planners' complaints appear justified to some extent. Perhaps DCPA should attempt to summarize guidance in a checklist format for use by local planners. However, the subject is a complex one and it is necessary for someone at the state and regional level to absorb and understand the detailed material.

Planner Comment: The organizational guidelines developed in the prototype plans for Colorado are not necessarily consistent with organizational set-ups in other states. Planners have trouble sorting out what is to be done at the regional level, what is to be done at the state level, and what is to be done at the local level.

Observation: Admittedly, organizational structures may vary from state to state, and the guidelines were developed by consultants who could bridge regional, state and local levels more easily than planners operating at one level or another. However, the prototype plans indicate what is generally expected at each level, so that planners should be able to sort out regional, state and local duties. The distinction between regional and state responsibilities may not always be clear-cut, but resolution of most conflicts should be possible at the regional level without holding up the planning process. Any attempts on the part of national DCPA headquarters to account for the organizational variety existing from state to state would increase the level of detail in the guidelines fifty-fold.

SPECIFIC COMMENTS ON FOOD GUIDANCE

Planner Comment: The USDA role is ambiguous. Defense Food Order No. 2 covers postattack distribution only. USDA representatives won't accept responsibility for preattack CRP food distribution, and won't develop food annexes for local plans.

Observation: There are several issues here. When the original guidance (Reference 3) was developed, the USDA had not officially adopted a position vis a vis CRP. They have since done so, declaring "USDA does not have operational responsibilities for CRP preattack." This new position has been reflected in earlier chapters of this report, and is included in an addendum to the revised planning guidelines of Volume II.

There never was any implication in the guidance that USDA would develop local food distribution plans for CRP purposes. This was

always the responsibility of the DCPA planner, acting with as much (or as little) help as the local USDA representative would provide. The ultimate responsibility for determining local food inventories rests with the DCPA planners, not USDA, and must be accomplished through food industry contacts.

Planner Comment: The DCPA headquarters requirement that state plans be produced before local plans is backwards in the case of food distribution. It's difficult to develop reallocation plans at the state level before you know who has what at the local level. Furthermore, in some instances, reallocation should be done regionally.

Observation: This comment appears to be valid. One jurisdiction (Region VI) has resolved this conflict by addressing only organizational issues in the first draft of the state annex, with the intention of addressing substantive reallocation questions once local plans are well underway.

It is also evident that in some regions where states cover small geographic areas and central wholesale warehouses serve many states, regional reallocation of food resources is more appropriate than a state-by-state reallocation. The reallocation principles are the same as those proposed at the state level in the prototype plans and guidelines.

Planner Comment: The food guidance requires the planner to collect too much information. "We (the planners) don't have the time or the money to devote to amassing the level of detailed information required by the guidelines." In some instances, food companies would not provide adequate volume data. In other cases, both planners and good industry personnel viewed certain information as extraneous.

Observation: The claim that the plans require too much detail is debatable at several levels. With regard to the time and manpower budget, the states appear to have at least as much manpower and time as the consultants who developed the various prototype plans and guidelines in the first place. In the case of the food plans, it is absolutely essential that state and local representatives contact key food industry personnel and obtain as much information as possible on existing food movements. The information is not only useful in planning, but the personal contact alerts and educates the food industry personnel, whose cooperation will be essential in time of emergency.

Even so, DCPA personnel should not attempt to apply pressure to food industry personnel who fail to cooperate or provide adequate data. In most cases, necessary data can be estimated from publicly-available statistics (see Guidelines, Volume II).

Where data appears to be extraneous in a particular situation, DCPA planners should be required to demonstrate that the information is in fact extraneous before arbitrarily omitting information from state and local plans. For example, if transportation stress is not a problem in a state, there may be no need for detailed information regarding the number of trucks maintained by each food wholesaler. The local jurisdictions should demonstrate by simple stress calculations that no problem exists before deciding not to collect truck inventory data.

Under no circumstances should local planners be allowed to bypass personal contact with key personnel in the local food distribution system.

Planner Comment: Planners suggested that a simpler alternative to the reallocation process would be to distribute food destined for the risk area according to the percentage of risk-area population assigned to specific host areas. That is, if 15% of the risk-area population went to host area "A", then 15% of the risk-area food would also go to the host area, in addition to the food already destined for that host area.

Observation: This suggestion oversimplifies the problem. The wholesaler responsible for 15% of the food movement into a risk area may not have any outlets in the appropriate host area. Wholesale assignments may have to be juggled to avoid organizational snafus and minimize distribution difficulties. The total increase in planned food movement to a specific host area will be the same under the guidance and under the simplified recommendation, but the food itself has a better chance of reaching evacuees if the wholesale chains are allowed to operate within systems that they know and trust.

Planner Comment: Since food and other commodities will probably be transported in closed vans, cubic volume measures appear to be more appropriate for computing transportation requirements than weight measures.

Observation: This point is well taken. The revised food guidelines contain cubic volume conversion factors for the most common food commodities.

Planner Comment: Redistribution orders should be initiated by host-area retailers rather than by food chain headquarters.

Observation: This is effectively the way the guidelines would work, particularly in the case of independent host-area retailers. However, the state or region must develop a reallocation plan so that the host-area retailers know how much to order from whom. In

the case of chains, the information on requirements may flow outward to the retailers, but the actual orders will flow inward.

7.2.3 General Responses to Observations

Where possible, the comments of the planners have been reflected in these report materials. In many cases, however, the comments reflect the need for a tightening and summarizing of all guidance materials, which was beyond the scope of the current contract. A few observations regarding the overall guidance and prototype materials are listed below.

1. At all levels, the planners interviewed were conversant with the DCPA guidance and, for the most part, were using these materials as a basis for their planning activities.

2. Although the DCPA guidance materials, in their present form, appear to provide a generally acceptable and consistent basis for planning, they might be improved through the development of summary material highlighting key points and providing a checklist for planners to follow.

3. The wide range of background experience of the many individual planners, and the significant differences between geographical areas and levels of responsibility, limits the applicability of any single guidance document. Because it is not feasible to produce specific guidance to cover each situation, it is desirable to provide interpretive sources. These may be supplementary written materials, oral briefings, or audio-visual materials.

4. Certain of the more detailed calculations required in the planning process proved confusing to several planners. Worksheets have been added to the revised guidance to help planners compute transportation stress, but more of these types of computation aids should be considered.

7.3 VALIDATION AT THE IMPLEMENTATION LEVEL

Final responsibility for implementing the food portions of the relocation plan under emergency conditions will rest with the members of the food, rail and trucking industries currently responsible for transporting essential commodities throughout the United States. To validate CRP plans at the implementation level, the planning guidance was discussed with a wide variety of food industry representatives. Members of industry trade associations were also interviewed, as were individual representatives of the rail and trucking industries. The reactions of food industry representatives to the CRP plans and guidelines are summarized in Section 7.3.2. The reactions of transportation industry representatives have been summarized in a separate report (Reference 52).

Where appropriate, their reactions have been incorporated in the case study of Volume I, as well as the planning guidelines and prototype plans of Volumes II and III.

7.3.1 Subject Areas Covered

At least fifty different representatives of the food industry were consulted for guidance in the process of constructing and validating the CRP guidelines. As appropriate to the respondent, the field interviews were structured to develop data and evaluate the guidance in terms of functional subject areas. These subject areas generally corresponded to the major areas of planning guidance, and focused on individual commodity movements through the production and processing levels of the supply chain. Wholesalers and retailers were interviewed regarding general warehousing and transportation practices. Major subject areas included:

A. Production

- A.1 Meat and Meat Alternates
- A.2 Milk and Dairy Products
- A.3 Eggs
- A.4 Cereal and Cereal Products
- A.5 Fruits and Vegetables
- A.6 Food Fats and Oils
- A.7 Potatoes
- A.8 Sugars and Sweets

B. Processing

- B.1 Meat and Meat Alternates
- B.2 Milk and Dairy Products
- B.3 Eggs
- B.4 Cereal and Cereal Products
- B.5 Fruits and Vegetables
- B.6 Food Fats and Oils
- B.7 Potatoes
- B.8 Sugars and Sweets

C. Distribution

- C.1 Warehousing
- C.2 Transportation
- C.3 Food Retailing
- C.4 Restaurants and Institutions

D. Prepar ation and Serving

E. Consumption

F. Postattack Considerations

- F.1 Processing Capacity Expansion and Conversion

7.3.2 Summary of Industry Contacts

In the case of the food industry, the validation process was a dynamic and ongoing part of the analysis itself. Industry representatives were contacted at every stage of development of the case study, guidelines, and prototype plans. Many of the procedures proposed in the guidelines were originally suggested by industry representatives, and most of the processing and distribution data contained in the case study came from industry representatives.

The large wholesalers interviewed in Colorado and elsewhere (Safeway, Associated Grocers, King Soopers, etc.) much preferred the option of keeping their risk-area warehouses open under crisis relocation conditions to transferring their goods to makeshift warehouses in the host area. It was their reaction, and their estimates of the time required to transfer goods, that led SYSTAN to recommend that all significant risk-area warehouses remain open and operating during the crisis. Only under conditions of extended crisis (i.e., only if the crisis evacuation period stretches beyond one or two weeks) should the option of transferring food to emergency host-area warehouses be undertaken.

In addition to checking the basic philosophy of continued risk-area operations with food industry personnel, the feasibility and practicality of several specific suggestions developed in the Colorado Springs study were reviewed with appropriate industry experts. Specific elements of the Colorado plans that were checked and rechecked with industry experts included:

- The ability of relatively invulnerable dried milk plants in Utah and Idaho to process raw milk production from Colorado was checked with plant officials. It was determined that the plants had sufficient excess capacity to dry Colorado's milk output, as well as that of neighboring states, in the likely event that Colorado's major milk processors were destroyed by attack.

- Options for increasing the capacity of food-processing plants were checked with the individual plant managers. It was this checking, for example, that led to the conclusion that the Peavy Company, the largest miller in Colorado, could increase its output by 75% under emergency conditions, and that the mill had sufficient excess grain inventories and railcars available to ship between one and two million bushels of grain to the host area during the relocation. Estimates of excess plant capacity were also checked with major Colorado milk, meat and vegetable processors.

- The feasibility of reactivating recently-closed host-area dairies was checked with a representative of the Sinton Dairy in

Colorado Springs. The representative had recently purchased equipment from a number of defunct dairies, and was aware of both their capabilities and the state of repair of the available equipment. It was his suggestion that the extra equipment currently warehoused by Sinton in Colorado Springs might be moved to the host area in time of emergency to help reactivate recently-closed dairies.

7.4 RECOMMENDATIONS

Virtually all of the suggestions and observations made by industry personnel have been incorporated in the draft guidelines. It is more difficult to know how to react to the suggestions and observations of DCPA planners. The planners employed by DCPA at the state and local levels reflect a wide range of backgrounds and experience, from highly-skilled professionals to those with little planning experience. This wide range of backgrounds and experience makes it difficult both to prepare an all-purpose set of guidelines and to monitor the work of the planners consistently. It is also difficult to give the competent planner latitude without giving the inexperienced planner an excuse for avoiding some necessary task. Specific recommendations which would improve the crisis relocation plans and planning process are:

1. Develop a Simplified Checklist for Planners. The planners' observation that there is too much material to plow through seems valid. DCPA should attempt to develop a simplified, summarized version of the planning guidance, explicitly specifying what is expected of each planner. The current guidance and case studies will provide useful background information for the more competent and highly-motivated planners, while the less experienced planners can follow the checklist and "do it by the numbers."

2. Emphasize the Need for Industry Contacts. In the case of food and transportation, it is essential that state and local planners contact key industry personnel. The information obtained is not only necessary for planning purposes, but the contact alerts and introduces industry personnel to DCPA thinking. These personnel will bear the ultimate responsibility for implementing any plans in times of crisis, so their cooperation and understanding is essential.

3. Allow Some Degree of Latitude in Local Plans. This is perhaps the most difficult suggestion to implement. Each time a competent planner is allowed to bypass a portion of the planning process that is unnecessary in his jurisdiction, several less perceptive planners may try to omit necessary elements in their jurisdictions. One method of minimizing the incidence of such occurrences is by requiring planners suggesting shortcuts to demonstrate that some specific element of the plan is unnecessary. As an example, a simplified computation of mini-

mal transportation stress might be accepted as grounds for bypassing the requirement that detailed vehicle inventories be required for each major food wholesalers.

4. Arrange for a Series of Regional Presentations by the Developers of the Guidelines. After being exposed to a visual presentation summarizing food and transportation planning guidance, several listeners in Region VI remarked that "....the guidance has never seemed so clear to me." Perhaps in this TV-oriented age, it is easier to educate planners through visual presentation than through the written word. Furthermore, the presence of the developer of the guidance allows a chance for questions to be cleared up directly. It might also be possible to develop a set of audio-visual materials that could be distributed to state and local planners.

5. Consider Developing Operational Summaries of the Plans Themselves. Several planners commented that the planning documents themselves seem too unwieldy for effective use in actual emergencies. Perhaps DCPA should also develop a master document for the specific use of EOC personnel that summarizes key actions and excerpts the information that a specific individual needs to function in time of emergency.

APPENDIX A

KEY COLORADO FOOD FACILITIES

WITH BLAST OVERPRESSURE

MEAT AND MEAT ALTERNATES

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Barber Poultry Inc.	Route 2 Box 790	Broomfield	Adams	2016	100-249	10 - 15
2	Litvak Mean Co. Inc.	5900 York	Denver	Adams	2011	100-249	110 -115
3	Martin Foods Co. Inc.	2011 E. 58th	Denver	Adams	2011	50-99	10 - 15
4	Wilhelm Foods Inc.	5590 High St.	Denver	Adams	2011	100-249	10 - 15
5	Averch Packing Co.	4900 Clarkson	Denver	Denver	2011	50-99	20 - 25
6	Central Packing Co.	5130 Race Ct.	Denver	Denver	2011	50-90	20 - 25
7	Foster Frosty Foods	1421 Oneida	Denver	Denver	2011	100-249	15 - 20
8	Pepper Packing Co.	901 E. 46th Ave.	Denver	Denver	2011	100-249	25 - 30
9	Ranch King Meat Packers	5800 York St.	Denver	Denver	2011	250-499	15 - 20
10	United Packing Co.	5000 Clarkson	Denver	Denver	2011	250-499	20 - 25
11	Wilson Beef & Lamb Co.	4950 Washington	Denver	Denver	2011	100-249	20 - 25
12	G&C Packing Co.	240 S. 21st St.	Colo. Springs	El Paso	2011	20-49	5 - 10
13	Sigman Meat Co. Inc.	6000 54th Ave.	Arvada	Jefferson	2011	500-959	5 - 10
14	Loveland Packing Co. Inc.	1000 S. Lincoln	Loveland	Larimer	2011	50-99	<1
15	Sterling Colo. Beef Co.	Right of Way Road	Sterling	Logan	2011	250-499	1 - 2
16	American Beef Packers	East of Fort Morgan	Fort Morgan	Morgan	2011	100-249	<1
17	Alpha Beta Acme Packing Division	303 Santa Fe Ave.	Pueblo	Pueblo	2011	100-249	2 - 5
18	Montfort Packing Co.	North 8th Ave.	Greely	Weld	2011	1000 or more	5 - 10
19	Colorado West Packers	140 Power Road	Grand Junction	Mesa	2011	20 - 49	<1

MILK AND DAIRY PRODUCTS

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Karl's Farm Dairy		Eastlake	Adams	2026	20-49	2 - 5
2	Alamosa Milk Co., Inc.	419 Main St.	Alamosa	Alamosa	2026	20-99	< 1
3	Beatrice Foods	1325 W. Oxford Ave.	Englewood	Arapahoe	2026	250-499	2 - 5
4	Lilly's Farm Dairy	5600 Clay	Denver	Denver	2026	20-99	5 - 10
5	Meadow Gold Home Delivery	5512 Leetsdale Dr.	Denver	Denver	2026	100-249	5 - 10
6	Roberts Foods, Inc.	2401 W. 6th Ave.	Denver	Denver	2026	20-99	30 - 35
7	Royal Crest Dairy, Inc.	350 S. Pearl	Denver	Denver	2026	50-99	15 - 20
8	Safeway Stores, Inc.	4301 Forest St.	Denver	Denver	2026	50-99	15 - 20
9	Sinton Dairy	5100 Cook St.	Denver	Denver	2026	100-249	20 - 25
10	Beatrice Foods Co.	115 East Cache La Poudre	Colo. Springs	El Paso	2026	20-99	5 - 10
11	Sinton Dairy	3801 N. Sinton Rd.	Colo. Springs	El Paso	2026	100-249	5 - 10
12	Clover-Rich-Hi Land Dairy	1315 Main Ave.	Durango	La Plata	2026	20-49	< 1
13	Poudre Valley Creamery Co.	222 La Porte Ave.	Fort Collins	Larimer	2026	50-99	< 1
14	Beatrice Foods Co.	450 25th St.	Greely	Weld	2026	100-249	< 1

CEREAL AND CEREAL PRODUCTS

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Colorado Milling & Elevator Co.	4545 E. 64th Ave.	Commerce City	Adams	2041	250-499	10 - 15
2	Colorado Milling & Elevator Co.	3750 Wynkoop	Denver	Denver	2041	250-499	20 - 25
3	Rust Sales Co.	1485 E. 61st St.	Denver	Denver	2045	50-99	10 - 15
4	ITT Continental Baking Co.	80 E. 62nd Ave.	Denver	Adams	2051	250-499	10 - 15
5	Golden Cream Donut Co.	1155 W. Evans	Denver	Denver	2051	50-99	10 - 15
6	Interstate Brands Corp.	5050 E. Evans	Denver	Denver	2051	100-249	5 - 10
7	King Soopers Discount Bakery	60 Yuma	Denver	Denver	2051	100-249	30 - 35
8	Rainbo Bread Co.	7300 Brighton Blvd.	Denver	Denver	2051	100-249	5 - 10
9	Safeway Stores Inc.	1315 9th St.	Denver	Denver	2051	100-249	15 - 20
10	Star Bread Co.	2744 W. Colfax	Denver	Denver	2051	100-249	25 - 30
11	Rainbo Bakers	330 E. 4th	Pueblo	Pueblo	2051	50-99	2 - 5
12	Keebler Co.	5000 Osage	Denver	Denver	2052	500-999	10 - 15
13	National Biscuit Co.	3100 E. 40th	Denver	Denver	2052	100-249	30 - 35

FRUITS AND VEGETABLES

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Kuner Empson Co.	40 N. Kuner Rd.	Brighton	Adams	2033	100-249	1 - 2
2	Skyland Food Corp.	West 9th Street	Delta	Delta	2033	100-249	<1
3	Ellis Foods Corp.	1575 Alcott St.	Denver	Denver	2033	50-90	10 - 15
4	Rust Sales Co.	1485 E. 61st Ave.	Denver	Denver	2033	100-249	15 - 20
5	Western Canning Co. Inc.	W. 2nd & Grant	La Junta	Otero	2033	250-999	2 - 5
6	Fort Lupton Canning Co.	511 McKinley Ave.	Fort Lupton	Weld	2033	100-249	<1

FOOD FATS AND OILS

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Litvak Meat Co., Inc.	5900 York	Denver	Adams	2077	100-249	10 - 15
2	Capitol Rendering Co.	E. 58th & York St.	Denver	Denver	2077	20-99	10 - 15
3	Rust Sales Co.	1485 E. 61st St.	Denver	Denver	2077	50 - 99	10 - 15

POTATOES

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Frito-Lay, Inc.	5101 E. Evans	Denver	Denver	2099	100-249	10 - 15
2	Mile High Redi Shops	4190 Madison	Denver	Denver	2099	10-19	30 - 35
3	Potato Specialties, Inc.	1590 Bryant St.	Denver	Denver	2099	20-49	20 - 25
4	Red Seal Potato Chip Co.	4300 Oneida St.	Denver	Denver	2099	100-249	15 - 20
5	Rio Grande Starch Co.	N.E. of Monte Vista	Monte Vista	Rio Grande	2046	50-99	<1
6	A.E. Staley Mfg. Co.	N. Washington	Monte Vista	Rio Grande	2046	20-49	<1
7	Kuner-Empson Co.	40 N. Kuner Road	Brighton	Adams	2033	100-249	1 - 2

SUGAR (BEET SUGAR)

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Great Western Sugar Co.	North of City	Brighton	Adams	2063	250-499	1 - 2
2	Great Western Sugar Co.	E. 3rd Ave.	Longmont	Boulder	2063	100-249	< 1
3	Holly Sugar Corp.	1st & Silver	Delta	Delta	2063	100-249	< 1
4	Great Western Sugar Co.	11th & Factory Ave.	Loveland	Larimer	2063	250-499	< 1
5	Great Western Sugar Co.	S. Front St.	Sterling	Logan	2063	250-499	1 - 2
6	Great Western Sugar Co.	W. Riverview Ave.	Fort Morgan	Morgan	2063	250-499	< 1
7	American Crystal Sugar Co.	Factory Grounds	Rocky Ford	Otero	2063	100-249	1 - 2
8	Great Western Sugar Co.		Ovid	Sedgwick	2063	100-249	< 1
9	Great Western Sugar Co.		Eaton	Weld	2063	250-499	< 1
10	Great Western Sugar Co.	1302 1st Ave.	Greely	Weld	2063	100-249	1 - 2
11	Great Western Sugar Co.	MSG Plant	Johnstown	Weld	2063	100-249	< 1

FOOD CHAIN AND WHOLESALE WAREHOUSES

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Safeway (also Bakery)	4600 E. 46th St.	Denver	Denver			15 - 20
2	Associated Grocers	5151 Bannock	Denver	Denver			15 - 20
3	Dillion Company (King Soopers) (also Meat Packing, Bakery)	65 Tijon	Denver	Denver			30 - 35
4	National Tea Co.	4120 Brighton Blvd.	Denver	Denver			25 - 30
5	Nobel Inc.	1101 W. 48th Ave.	Denver	Denver			10 - 15
6	Flaks-Colo. Springs	19 W. Cucharras	Colo. Springs	El Paso	5141		2 - 5
7	Portion Foods	717 Nichols Blvd.	Colo. Springs	El Paso	5141		5 - 10

Note: The above facilities all sustain substantial damage. The other (smaller) companies are probably located mainly in the central business district. An off-hand guess is that 3% survive undamaged.

REFRIGERATED WAREHOUSING

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Beatrice Foods	4770 N. Wash St.	Denver	Denver	4222		20 - 25
2	Beatrice Foods Co.	1801 Wynkoop St.	Denver	Denver	4222		10 - 15
3	Booth Fisheries	1600 W. Colfax	Denver	Denver	4222		25 - 30
4	City Ice Co.	2101 31st St.	Denver	Denver	4222		20 - 25
5	Colorado Ice & Cold Storage	1700 W. Colfax Ave.	Denver	Denver	4222		25 - 30
6	Cudahy Packing Co.	4801 Brighton Blvd.	Denver	Denver	4222		25 - 30
7	Merchant Refrigeration Co.	5120 Race Court	Denver	Denver	4222		20 - 25
8	Pepper Packing Co.	901 E. 46th Ave.	Denver	Denver	4222		25 - 30
9	Barbers Poultry, Inc.	Route 1, Box 68	Broom-field	Adams	4222		10 - 15
10	Tomahawk Packing Co.		Austin	Delta	4222		< 1
11	United Packing		Austin	Delta	4222		< 1
12	Palmer & Company	255 Cedar Mesa St.	Cedar-edge	Delta	4222		< 1
13	Cookdale Dairy & Meat	3020 Highland Ave.	Canon City	Fremont	4222		< 1

GRAIN STORAGE*

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Cargill, Inc.	1451 Cargill Dr.	Denver	Adams	4221		10 - 15
2	Denver Flour Mills/Colo. Milling & Elevator Co.	64th & Brighton	Denver	Adams	4221	100-249	15 - 20
3	C.M. Kellogg Grain Co.	52nd & Colorado Blvd	Denver	Denver	4221	250-499	20 - 25
4	Farmers Marketing Assn.	4545 Madison	Denver	Denver	4221		30 - 35
5	Garvey Elevators Inc.	20th & Wazee St.	Denver	Denver	4221		10 - 15
6	Strasburg Farmers Elev.	P.O. Box 226	Strasberg	Arapahoe	4221		< 1
7	Cogburn Grain Co.	P.O. Box 265	Bartlett	Baca	4221		< 1
8	Springfield Coop Sales	----	Spring-field	Baca	4221		< 1
9	Bartlett & Co. Grain	P.O. Box 38	Walsh	Baca	4221		< 1
10	Cash Coop	----	Walsh	Baca	4221		< 1
11	Adolph Co.	----	Delta	Delta	4221		< 1
12	Equity Coop Exchange	----	Burl-ington	Kit Carson	4221		< 1

*Denver SMSA

EGG WHOLESALERS

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	A&A Egg Co.	255 Stuart	Denver	Denver	5144		15 - 20
2	AAA Meat Co.	311 S. Chestnut	Colorado Springs	El Paso	5144		2 - 5
3	Boulder Valley Farms	East of Boulder	Boulder	Boulder	5144		10 - 15
4	Inland-National Foods	2901 N. El Paso	Colorado Springs	El Paso	5144		5 - 10
5	Keslers Egg Market	201 Denargo Market	Denver	Denver	5144		15 - 20
6	Richgold Poultry Farms	South of Parker	Parker	Douglas	5144		<1
7	J.A. Sharroff & Co.	3825 LaFayette 1644 Market St.	Denver	Denver	5144		5 - 10
8	A&M Poultry, Inc.	10319 Yellowstone Rd.	Longmont	Boulder	5144		<1
9	Fowler Creamery	206 E. Santa Fe	Fowler	Otero	5144		<1

(No data on employment, but J.S. Sharoff has one of the largest undamaged capacity, estimated at 5%.)

POTATO STORAGE

NUMBER	NAME	ADDRESS	CITY	COUNTY	SIC CODE	EMPLOYMENT RANGE	BLAST OVERPRESSURE (psi)
1	Canon Potato Co.	Southeast of Center	Center	Saguache	4221		< 1
2	Center Potato Growers	710 East 3rd	Center	Saguache	4221		< 1
3	Fairview Farms, Inc.	Route 1, Box 39 Southeast of Center	Center	Saguache	4221		< 1
4	Fallis Potato Co.	841 E. 3rd	Center	Saguache	4221		< 1
5	McClure Potato Co.	789 E. 2nd	Center	Saguache	4221		< 1
6	Pepper Potato Co.	West of Center	Center	Saguache	4221		< 1
7	Still Farms of Center	Southeast of Center	Center	Saguache	4221		< 1
8	Marshall Produce	Route 2	Center	Saguache	4221		< 1
9	Del Norte Potato Grower	250 Oak St. Coop	Del Norte	Rio Grande	4221		< 1
10	G&R Farms	Route 1	Monte Vista	Rio Grande	4221		< 1
11	Canon Potato Co.	South of Center	Center	Saguache	4221		< 1
12	Grower Shipper Big 8	Stockyards & RR Track	Monte Vista	Rio Grande	4221		< 1
13	Hodgell Farms, Inc.	Route 1	Monte Vista	Rio Grande	4221		< 1
14	Lyman Wright & Sons	---	Monte Vista	Rio Grande	4221		< 1

APPENDIX B

USDA STATE EMERGENCY MEMORANDUM NO. 60

(CRISIS RELOCATION PLANNING)

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

March 23, 1977

USDA STATE EMERGENCY MEMORANDUM NO. 60

Crisis Relocation Planning (CRP)

1 PURPOSE

To provide guidance to USDA State Emergency Boards when asked by State and local civil defense officials for assistance in developing plans for crisis relocation.

2 BACKGROUND

A DCPA has developed the concept of temporarily relocating people in time of an international crisis from those areas felt to be high risk areas, due to the possible direct effects of nuclear weapons, to host areas considered to be low risk.

B Some States have begun developing plans to provide the necessary food, water, medical supplies, protection against radioactive fallout, etc., which would be required in relocating to host low risk areas.

C The development of plans for crisis relocation will require the cooperation of State and local governments and various Federal agencies.

D USDA does not have operational responsibilities for CRP preattack. (See ASCS Handbook 1-DP, subparagraph 105-B, and the questions and answers attached to this memorandum.)

3 STATE ACTION

The Chairman of the USDA State Emergency Board shall:

A Act as the USDA contact for liaison purposes in helping State and local civil defense officials develop plans for crisis relocation.

B When requested by State and local civil defense officials, provide information for use in developing these plans.

C Use the food facility listings if required to identify major food processors and wholesalers. Follow instructions in ASCS Handbook 1-DP if copies of the facility listings are requested. Paragraph 157 covers restrictions on release of data, and paragraph 158 covers handling requests for facility listings. Exception: Do not waive payment of fees.

D Advise the Chairman of the USDA Regional Emergency Staff on CRP activities.

E Include CRP activities in the semiannual report.

4 MEMORANDUM DISPOSAL

When incorporated in EOH.

James S. Wood

JAMES S. WOOD, Acting
Assistant to the Secretary
Intergovernmental Affairs

Attachment

Questions and Answers for SEB's on Activities Relating to Crisis Relocation Planning

1. At what stage could (and would) USDA envision establishing interstate controls of food supplies to reasonably insure the continuation of normal flow?

   USDA will not establish any interstate controls over the movement of food supplies during the preemergency period. Understanding should be agreed upon between State civil defense and the food industry as to alternate delivery and distribution points.

2. If and when USDA would assume a supporting role (to the State Food Organization) what agencies would provide what support subfunction between ASCS, FNS, CES, AMS? Does the Commodity Credit Corporation have a role in emergency food support short of war?

   USDA would not assume any supporting role. The SED-ASCS, as Chairman of the SEB, would be the point of contact for liaison purposes during the preemergency planning for CRP. FNS could possibly lend some support in the area of food stamps if the current law would permit. However, States could use supplies in the school lunch system for mass feeding operations.

   The Commodity Credit Corporation does not have a role in food support pre-attack.

3. The USDA Emergency Operations Handbook for USDA State and County Emergency Boards indicates that the SEB's and CEB's function for emergency food support is now limited to natural disasters and attack/attack warning situations. If the S&CEB system does not function during the planning and preparation phase, what mechanism does USDA have, or could establish to carry out the preparation of plans and develop programs to fulfill the responsibilities assigned in Part 8, EO 11490, as amended, in a crisis relocation situation?

   The SEB's and CEB's carry out the preemergency plans and programs developed by national headquarters. They participate in exercises not only in the food area, but in the other responsibilities assigned to USDA by EO 11490. USDA plans (basically Defense Food Order No. 2 regarding food) are designed to permit the food industry (processors and wholesalers) to function with a minimum amount of restrictions. Food for natural disasters is not a board function. It is an agency function of FNS, and FNS is not a member of the board.

4. Has any planning and preparation been done by USDA for recordkeeping requirements at local and State levels if and when USDA established controls on food supplies? Recordkeeping envisioned for payment?, resupply?, inventory control?

   The only recordkeeping USDA has for emergency reporting is the capability of the primary facilities to operate. This does not include any inventory that the facilities may have. Guarantee of payment procedures only apply to limited situations in a postattack environment.

5. Will USDA establish any controls on food distribution transportation, particularly interstate, to insure reaction to redirection of the food distribution flow from out-of-state and from risk to host areas within the State? Are any food transportation policies established?

   Transportation policies have been established by the Department of Commerce and Department of Transportation as prescribed by the National Plan for Emergency Preparedness and EO 11490, as amended. USDA will not control any transportation. USDA is a claimant for transportation. Food does carry a high priority and DOT does not envision that movement would be restricted if equipment, operators, and fuel were available.

6. Will USDA provide for establishing rationing of food products? If so, what would be the criteria and policies for food rationing? Could and/or would this be done when CR option is implemented? If USDA is not going to plan and prepare for rationing, who will?

   According to the National Plan for Emergency Preparedness, State government is responsible for consumer rationing. USDA has not, and will not prepare any plans for rationing.

Excerpt from

ASCS HANDBOOK 1-DP (REV. 1)

Defense Programs and Services
for Field Offices

(Dated 9/22/76, Amend. 1, PART 4, Paragraph 105, pp. 46-47)

105 CRISIS RELOCATION PLANS

A Background.

1 Studies have been made by DCPA investigating the feasibility of relocating the population of areas of high risk in anticipation of a nuclear attack.

2 Prototype plans for food distribution under these circumstances indicate that normal distribution facilities would be used to serve the evacuated population.

3 Alleviating stress on transportation, food facilities, and the host areas resulting from relocation of population will require close cooperation of State and local officials and the USDA emergency boards.

B CEB and SEB Action.

1 None required before DFO No. 2 is put into effect. Adjustment of food distribution patterns would be made by the food industry and State and local officials. EXCEPTION: When called upon, assist State and local civil defense officials in DCPA's Crisis Relocation Planning (CRP) in high risk areas.

2 After DFO No. 2 is put into effect provide specific direction to food industry within the scope of the order.

PLAN TO SURVIVE

Survival of food facilities will be essential to providing a supply of food adequate to meet the needs of our country in a national emergency. Each element in the food industry chain is a key link in providing this food. Plan now for survival of your business.

Prepare general emergency plans.

Include clear instructions on shutdown procedures and emergency actions.

Establish emergency command patterns. Assign and train a principal and alternate person for each post.

Assign specific emergency duties to each employee and provide training in those duties.

To assure success in case of need, thoroughly test your emergency plan and schedule regular practice of the plan.

Use protective construction techniques on new construction.

Provide fallout protection for all personnel.

Where practical, use underground or partly underground construction.

Use windowless construction to reduce vulnerability to fire.

Reduce susceptibility to blast damage by channeling utilities through a reinforced concrete floor.

Upgrade the existing plant and reduce physical vulnerability through a normal program of plant improvement.

Modify buildings where practicable.

Improve grounding and shielding of electrical panels and controls.

Improve protection of complex machinery and equipment against damage.

Improve fallout shelter capability of plant.

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SEPTEMBER 1977

FOOD IN A NATIONAL EMERGENCY

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE

U.S. DEPARTMENT OF AGRICULTURE
PROGRAM AID NO. 1197

A guide to understanding Standby Defense Food Order No. 2 for food processors, wholesalers, chain store distribution centers, and operators of commercial food storage facilities in the United States, Puerto Rico, and the Virgin Islands.

The Nation must be prepared for prompt, effective action in case of a national emergency. Advance knowledge by the food industry about what to do will aid survival and recovery operations.

"National Emergency" is defined as an attack upon the United States or proclamation of a civil defense emergency by the President or by concurrent resolution by Congress because an attack is believed imminent.

This guide provides instructions to the food industry for handling raw and processed foods in its possession and for providing for their storage, conservation, efficient processing, and orderly and equitable distribution in the early period after a national emergency. The guidelines contained in this publication are subject to change as circumstances warrant. The United States Department of Agriculture (USDA) and State agencies will advise the food industry as changes are made.

The USDA is responsible for planning and carrying out the emergency program governing the processing and distribution of food from the farm to the local retail store. By agreement, part of these responsibilities will be shared with State governments in some States. State agencies are responsible for the emergency program relating to distribution of food to ultimate consumers at the local retail store level. These programs have been developed in consultation with other Federal agencies, State governments, and representatives of the food processing and distribution industries.

Standby Defense Food Order No. 2 and two suborders, incorporating the main program provisions, will be issued in a national emergency and will become the "Order Administrator's" principal instrument for the control of the processing and distribution of foods for civilian and military consumption. The Order Administrator is the Secretary of Agriculture, or the chairman of the USDA State Emergency Board. In the preemergency period—prior to a determination that a national emergency exists—the chairman is the State Executive Director of the Agricultural Stabilization and Conservation Service (ASCS).

The food industry, especially those involved in the processing, storage, and distribution of food, should become familiar with the contents of this guide and follow its instructions in case of national emergency. *This guide should be reviewed with key personnel and kept with important papers.*

WHAT TO DO IF YOU ARE:

The Operator of a Chain Store Food Distribution Center
The Operator of a Commercial Food Storage Facility
A Food Processor
A Food Wholesaler

Report the operating capability of your facility within 5 days after civil defense authorities permit access to it. Make the report directly to the Order Administrator in care of the USDA County Emergency Board in the county in which the facility is located.

During the preemergency period, the chairman of the County Emergency Board will be located in the county ASCS office. During the postemergency period (following a determination that a national emergency exists), the board will operate from the same location as other key county offices and officials.

Make every practicable effort to protect all food stocks that are within the confines of your facility.

Do not distribute food outside of normal trade channels nor directly to ultimate consumers, except when authorized by the Order Administrator to make deliveries to specified locations.

Establish normal business relationships with new customers regarding payment for goods and services, and continue these relationships with previous customers. Notify the USDA County Emergency Board if financial arrangements with new customers cannot be agreed upon.

Base distribution of food to consumer outlets on their written confirmation of the expected number of consumers to be served. Do not exceed the USDA National Emergency Maximum Food Allowance, or the local government ration level.

Fluid milk and fresh fruits and vegetables, except potatoes, are exempt from distribution restrictions.

Do not accumulate inventories of fresh or processed foods in excess of reasonable need for civilian distribution.

Meet all military requirements.

Hold sufficient quantities of food to satisfy undelivered portions of existing military contracts.

Do not distribute for civilian use any food owned by the military until released by the military.

USDA EMERGENCY ORGANIZATION

The boards and staffs described below are made up of representatives of USDA agencies which, in addition to their regular day-to-day program assignments, have been selected to assist in carrying out USDA defense responsibilities.

USDA COUNTY EMERGENCY BOARDS (CEB's) provide coverage for every county and would act as the initial contact point for members of the food industry in a national emergency or for guidance during preemergency. In most cases, the chairman is the County Executive Director of the ASCS.

USDA STATE EMERGENCY BOARDS (SEB's) have been set up in each State and Puerto Rico/Virgin Islands. The chairman is the ASCS State Executive Director.

USDA REGIONAL EMERGENCY STAFFS have been designated in each of the 10 Federal regions with headquarters in Boston, MA; New York, NY; Philadelphia, PA; Atlanta, GA; Chicago IL; Dallas, TX; Kansas City, KS; Denver, CO; San Francisco, CA; and Seattle, WA.

ADDITIONAL GUIDANCE

CHAIN DISTRIBUTION CENTERS

Assume the role of a wholesaler and distribute food stocks as equitably and continuously as possible to your chain's consumer outlets and to other consumer outlets who request food supplies even though they may not be part of the chain's operation.

Other consumer outlets may include independently owned chain stores, chain and independent food service operations, or other away-from-home eating places including emergency feeding centers designated by State and local governments.

Establish a normal wholesaler-retailer business relationship with new customers regarding payment for goods and services rendered.

Deliver food to consumer outlets at any interval of time which promotes orderly and efficient distribution.

Cases, boxes, bags, or other normal packaging units need not be broken to meet established maximum distribution rates.

FOOD WHOLESALERS

Distribute food stocks as equitably a continuously as possible to previo customers and to other establish consumer outlets who request fo supplies, even though they may not ha been previous customers.

Other consumer outlets may include cha stores, chain and independent food servi operations, or other away-from-hon eating places including emergen feeding centers designated by State a local governments.

Deliver food to consumer outlets at a interval of time which promotes orde and efficient distribution.

Cases, boxes, bags, or other norm packaging units need not be broken meet established maximum distributi rates.

If you have done business with t military during the immediate precedi 12 months, set aside a portion of yo current inventory equal to the percent your total business with the military.

FOOD PROCESSORS

Continue your normal processing operation to the extent practicable.

Use raw foods and ingredients to provide the optimum output of end products.

Do not use sugar or other natural sweeteners as an ingredient in excess of 50 percent of recent or seasonal use.

Adjust formulas to obtain optimum product output.

Take all reasonable precautions to assure that the food processed or the end products obtained are fit for human consumption.

Distribute products on hand or subsequently processed through established trade channels as equitably and continuously as possible.

Make distribution to wholesalers a chain store distribution centers requesti food even though they may not have be a prior customer. Distribution directly consumer outlets (local retail stores a food service establishments) is permitte operators of outlets were previo customers or it is necessary to bypass omit steps.

Set aside a portion of your current ventory equal to the percent of your to business with the military if you have do business with the military during t immediate preceding 12 months.

Hold food already processed for a milit contract, but undelivered, for disposit by the military.

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EFFECTS OF ATTACK ON FOOD DISTRIBUTION TO THE RELOCATED POPULATION by John W. Billheimer and Arthur W. Simpson; Final Report, September 1978, Contract DCPA01-76-C-0312, Work Unit 2312F, 350 pages.

This study extends previous research into food distribution under crisis relocation conditions by (1) investigating the effects of a nuclear attack on the reconfigured food distribution system and the relocated population, (2) identifying and evaluating alternative means of providing food to the relocated population following such an attack, and (3) reviewing existing crisis relocation guidance in the light of the probable postattack consequences. Under a crisis relocation strategy, the percentage of population surviving a nuclear attack is likely to exceed both the percentage of surviving agricultural resources and the surviving food processing and distribution capability. A case study of Colorado Springs, Colorado indicates that two of the most serious food distribution problems following an attack are likely to be (1) transportation system strain resulting from geographic supply/demand imbalances; and(2) local distribution breakdowns resulting from damage to vulnerable wholesale warehouses. Each of these problems will be exacerbated by a strategy of crisis relocation.

In the long run, both the national food distribution system and its local Colorado extension appear to be sufficiently flexible to adapt to a wide range of postattack conditions. However, neither the national nor the local system as currently constituted can be altered as quickly as immediate postattack conditions might warrant. Critical shortages of most commodities can be anticipated immediately following an attack, with shortages of meat and dairy products being particularly severe.

On the basis of the case study, prototype crisis relocation plans for the State of Colorado, the Colorado Springs area, and a representative reception area (Fremont County, Colorado) have been revised and updated to reflect postattack concerns. Guidelines for state and local relocation planners in other areas have been similarly updated.

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